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PERINEPHRITIC ABSCESS

A REVIEW OF CASES OPERATED ON AT THE MASSACHUSETTS GENERAL HOSPITAL FROM 1899 TO 1913[1]

BY EDWARD P. RICHARDSON, M.D., F.A.C.S., BOSTON

Surgeon, Out-Patient Department, Massachusetts General Hospital; Surgeon, Robert B. Brigham Hospital; Assistant in Surgery, Harvard Medical School

THIS paper is based upon the cases classed as perinephritic or paranephritic abscess, 59 in number, operated on at the Massachusetts General Hospital during the fifteen years 1899 to 1913. For permission to report these cases I wish to thank the members of the staff of the hospital who operated on them.[2] Although perinephritic abscess presents a simple problem purely from the point of view of surgical treatment, yet the etiology is often obscure and the diagnosis in individual cases difficult. It is from the point of view of etiology particularly that I wish to consider the present series.

Included as perinephritic or paranephritic abscess are cases of varied origin and clinical course. Many factors make the determination of the probable source difficult. The long duration of the disease, the frequent inadvisability of completely exposing the kidney, the difficulty of determining the focal point in a large abscess cavity, the indefiniteness of clinical symptoms in renal disease limited to the cortex, may tend to obscure the cause of suppuration in any given case. Two large groups of cases may be made: first, cases in which the suppuration apparently originates in the perirenal fat primarily, and, second, those cases in which it is a continuation of disease from adjacent organs or structures. The latter class of cases may be divided into the secondary to disease of the kidney and those secondary to disease of other adjacent organs or tissues, particularly the intestinal tract, spine, ribs, or pleura.

This fact stands out in the majority of reported series. In many cases, and perhaps the majority, there is no definite local source for suppuration to be found, whether in the kidney or in adjacent organs or structures. It is the etiology of this group of cases, those of concealed origin, that I wish to discuss.

In this group, sometimes called primary cases, we have three possible sources of suppuration: first, through the lymphatics, second, through the blood stream by metastatic infection, and, third, from overlooked renal lesions. Trauma may be an important contributing factor, whatever the source of

[2] These cases were operated on by the following present and past members of the Staff: Dr. F. G. Balch, Dr. H. H. A. Beach,* Dr. G. W. W. Brewster, Dr. W. A. Brooks, Dr. A. T. Cabot,* Dr. Hugh Cabot, Dr. Farrar Cobb, Dr. E. A. Codman, Dr. W. M. Conant, Dr. Lincoln Davis, Dr. J. W. Elliot, Dr. R. B. Greenough, Dr. F. B. Harrington,* Dr. S. J. Mixter, Dr. J. G. Mumford,* Dr. C. A. Porter, Dr. C. B. Porter,* Dr. C. L. Scudder, Dr. M. H. Richardson,* Dr. Hugh Williams.
*Deceased.

[1] Read before the Southern Surgical and Gynecological Association, Asheville, North Carolina, December 16, 1914.

infection, through producing hæmorrhage in the fat capsule or some other point of lowered resistance.

The possible lymphatic origin of perinephric suppuration is obvious. The communication of the lymph-vessels of the cortex with those of the perinephric fat through the fibrous capsule, of the ureter with those of the kidney and bladder, the connection of the lymphatics; of the perinephric fat with those of the diaphragm, the further connections through the lumbar, iliac, and hypogastric nodes, suggest many possible sources of infection. Stewart (1) and Sweet and Stewart (2) have shown the great importance of ureteral lymphatics in ascending infections of the kidneys and perinephric tissues. Miller (3) has emphasized the importance of the anatomical relation of the perinephric fat to the lateral lumbar glands.

There is also evidence, both clinical and experimental, in favor of metastatic infection of and suppuration in the fat capsule through the blood stream. This might take place either directly, through the vessels of the fat capsule itself, or indirectly, through the formation of lesions in the renal cortex or fibrous capsule, with rupture or extension into the perirenal fat.

Bacteria, injected into the blood stream of animals in sufficient quantities, are excreted in part by the kidneys. This is probably a pathological rather than a purely physiological phenomenon. Brewer (4 and 5) showed that if the resistance of one kidney were lowered by such factors as trauma or interference with the circulation, septic infection of that kidney might follow the injection of pathogenic bacteria into the blood stream. Injecting the staphylococcus, J. Koch (6) found that the toxins of the bacteria themselves, and Rehn (7), that a short chloroform anæsthesia, was sufficient to lower the kidney resistance and permit the occurrence of a septic nephritis with local renal abscesses, frequently subcapsular. On account of the lack of a definite fat capsule in animals, such a septic hæmatogenous nephritis rarely results in perinephric abscess. Schnitzler (8) found that such injection, followed after weeks by trauma, caused perirenal suppuration.

Clinically the occurrence of hæmatogenous septic nephritis has been brought to general attention by Brewer. It is well to remember, however, that such infection, as well as occurring in the form of fulminating cases demanding nephrectomy, and mild cases subsiding without operation, may produce local abscess of the kidney. Such abscesses are usually cortical, frequently single, and due to the staphylococcus in a great majority of cases. They tend to rupture into the perirenal fat rather than into the pelvis, and through extension may be the source of perirenal abscess. Their clinical symptoms may be indefinite, and they may produce either no change in the urine or so slight a change that it is overlooked. Consequently it is impossible practically to classify perinephritic abscess cases as renal or non-renal through urinary examination.

As further evidence of the possible metastatic origin of perinephric suppuration, either directly or through the agency of the kidney, we have series of cases of local cortical abscess of the kidney and of perinephric abscess, due to the staphylococcus, following peripheral pus foci, particularly furuncles, carbuncles, and paronychiæ. This association, pointed out by Jordan (9 and 10) and Israel (11), has been followed by a series of cases reported by Jáffe (12), Cahn (13), W. Albrecht (14), F. Koch (15), Herczel (16), Müller (17), Rehn (7), Coenen (18), Baum (19), Hartzbecker (20), Zinn (21), Schnitzler (22), Friedman (23), and others. These authors agree that in such cases infection is metastatic through the blood stream, and that perirenal suppuration may be due to the rupture of a preceding cortical abscess. In this partial review of the literature, 108 cases are reported due to metastatic infection. In 9 of them the abscess was limited to the renal cortex; in 24, the perinephritic abscess was apparently an extension of a cortical renal abscess; in the remainder the source of suppuration was not demonstrable at operation. In these cases perirenal suppuration was preceded by furuncles 55 times, by paronychiæ or septic fingers 21 times, by carbuncles 10 times, by various local abscesses 11 times, by tonsillitis and septic wounds, each 3 times. In 21

cases showing ruptured or non-ruptured cortical abscess, the urine was stated to be negative 12 times. The usual infecting organism was the staphylococcus, occurring 32 times alone, once each with the streptococcus and the colon bacillus. The streptococcus occurred twice.

Rehn believes his experiments show the genesis of perirenal abscess in two ways: first, through primary cortical metastasis, with wandering of virulent organisms through the fibrous capsule and destruction of the same, and, second, through primary metastasis in the fibrous capsule itself, and that these results are fully applicable to man.

Now what evidence in favor of metastatic hæmatogenous infection do the present series of 59 cases present? For the purpose of this paper the cases may be divided roughly into three groups. First, cases which are due to direct extension of suppuration from neighboring organs or structures outside the renal fascia. In this group are five cases, two men and three women, with two deaths. Infection here was due to tubercular abscess, apparently pancreatic (death), to acute abdominal sepsis in a woman seven months pregnant (death), to retroperitoneal abscess following gangrenous appendicitis, to tuberculosis of spine, and to disease of the twelfth rib. These cases are properly classed as retroperitoneal or lumbar abscess, and need not concern us further.

In the second group are included cases with antecedent or predominant diseases of the kidney or urinary tract, excluding a past urethritis without sequelæ; a total of 20 cases, 16 males and 4 females, with 4 deaths. The youngest patient was 19, the oldest 57. By decades the ages were:

19 to 30 years	7 cases
31 to 40 years	4 cases
41 to 50 years	5 cases
51 to 60 years	4 cases

or 35 per cent of these cases were 30 years of age or under.

Culture from the pus from the perinephritic abscess taken in 8 cases gave no growth 5 times, bacillus coli, staphylococcus aureus, a bacillus with a streptococcus, each once.

In this group tuberculosis of the kidney occurred four times with one death, one secondary nephrotomy and two secondary nephrectomies. Pyelonephritis, apparently non-tubercular, occurred three times, with one primary and two secondary nephrectomies. Pyonephrosis was present three times, twice with stone, with 2 deaths. Divulsion of stricture of the urethra was followed by perinephric abscess in one case. In one case there were calculi and diverticula of the bladder, with deficient excretion from the kidney on the affected side. Three cases gave a history of repeated attacks of renal colic, and had passed stones by urethra. In one of these, nephrotomy and exploration of the other kidney was followed by death. One case showed stone by X-ray, but the kidney was not exposed at operation. In four cases the kidney was stated to feel diseased at operation, but particulars were not given. In some of these cases, suppuration was obviously due to direct extension from the kidney. In others, although the exact method of development is obscure, there is at any rate the possibility that the perinephric infection was dependent upon the condition of the kidney or urinary tract.

Hæmatogenous septic infection is, of course, not excluded from playing a rôle in these cases. The situation is simpler, if we limit consideration of the rôle played by it to the remaining cases. The present group of cases, although extremely important, need not for the purpose of this paper be discussed further.

After separating the above rough groups, 34 cases remain. This last group, many cases of which would formerly be classed as "primary," I wish to discuss more in detail, and will limit my remarks from here on to this group. Their common factor is, in general, absence of symptoms referable to the urinary tract. It is obvious that they may develop from infection brought from a distance by the lymphatics. What evidence is there of metastatic infection through the blood?

This group includes 33 males and 1 female. All cases recovered from operation. Their average age was 29; the youngest was 12 and the oldest was 56; 29 of them were under 40. Arranged by decades, the ages were as follows:

From 10 to 20 years	8 cases
From 21 to 30 years	13 cases
From 31 to 40 years	8 cases
From 41 to 50 years	3 cases
From 51 to 60 years	2 cases
	34

or 62 per cent were 30 years of age or under.

The pus was examined in 21 cases. Thirteen cases showed staphylococcus aureus, 3 a staphylococcus, one each the streptococcus in mixed culture, the bacillus coli, an unidentified bacillus, and no growth. One case, with preëxisting sinus, showed a streptococcus. If the infection were commonly from an intestinal source, we should not expect such a predominance of the staphylococcus in pure culture.

A few cases showed a possible source of infection in peripheral suppurating focus. The following case is an example:

CASE 1. T. C., male, age 33, No. 181,686; admitted March 21, 1912. History: Denies venereal infection. Three weeks ago had lymphangitis of left arm following cut on wrist. Twelve days ago slipped from a tree and "strained" left side. Four days later began to notice dull heavy pain in left flank. No definite chill. No disturbance of urination. Has been in bed two days. No vomiting. Has walked lame since pain has been present. Physical examination: Left thigh drawn up; abdomen soft; no costovertebral tenderness. Marked tenderness along lower border of ribs extending into left lower quadrant just above Poupart's ligament. No mass felt. On left wrist a linear scar one inch long. Just posterior to this are two furuncles, one discharging. Urine examination: Faint trace of albumin; a few leucocytes and red blood-corpuscles; white count 21,300.

Seen by Dr. Codman, and condition regarded as acute hæmatogenous kidney. No operation advised. March 26, blood culture negative. Temperature runs between 99° and 102°. March 29, tenderness in flank increasing.

April 1, operation by Dr. C. L. Scudder. Loin incision, opening abscess in kidney region containing non-offensive creamy pus. Kidney not seen or felt. Culture from pus: profuse growth of staphylococci.

Blood culture April 3, no growth. Urine entirely negative on eight examinations following first.

Good convalescence. April 18, discharged.

CASE 2. A boy of fifteen was confined to the house six weeks before entrance, by furunculosis. Two weeks later he developed a pain in the back and five days ago there was swelling in the right loin. The urine was negative on examination. Operation by Dr. G. W. W. Brewster showed a large abscess posterior to the kidney, containing odorless pus, which on culture showed a staphylococcus.

CASE 3. This patient is said to have had pain in the back eight weeks before admission, coincidentally with boils of the head and neck. Operation by Dr. C. L. Scudder showed a small abscess outside of the kidney capsule. On culture the staphylococcus aureus was found.

The first two of these cases distinctly suggest a metastatic source of infection. The record in the last case does not show any lapse of time between the furunculosis and the onset of pain.

Two cases followed erysipelas (facial in one instance, not stated in the other), and one case a streptococcus infection of the shoulder-joint. In all three of these cases, however, the staphylococcus was found in the perinephric abscess. In one case lumbar pain followed a week after sore throat and cervical adenitis. One case followed influenza and one a bronchitis. No other infectious processes occurring within three months were mentioned. In spite of the frequency of suppurative lesions draining into the lymphatics in the neighborhood of the fat capsule, they have not been conspicuous in this group.

Trauma has not been common in this series, and was definite only in one other case, a fall on the back from a table.

It is impossible to state from the records to what extent cortical abscess of the kidney may have been responsible for perirenal suppuration in this group. One case showed an induration the size of a dime on the cortex, with a dimple and a superficial sinus in the center. This lesion distinctly suggests a cortical abscess, largely healed. This case is the only one of the 34 in which the kidney was completely exposed. In only 12 others was it felt in its relation to the abscess cavity.

The following two cases, not included in this series, suggest that perirenal suppuration may have been headed off by early operation. One, operated on the fourth day by Dr. Daniel Fiske Jones, showed abscess in the lower pole, about to extend into the perirenal fat. The other, operated on the fifteenth day by Dr. Lincoln Davis, showed a solitary abscess under the fibrous capsule. Both were due to a staphylococcus. In the second case the urine was entirely negative.

Both cases report themselves well ten and three years after operation.

Only 12 of the 34 cases showed an entirely negative urine before operation. Leucocytosis was present in all but one of the 34 cases. Blood culture was negative in 6 instances.

The type of onset varied from sudden sharp pain, suggesting in a few cases renal colic, to an insidious onset, in which the presence of a lumbar mass first called attention to the probable diagnosis. In 7 cases the onset was distinctly sudden, in 2 cases with an initial chill. Occasionally a period of remission followed.

Complications were few. Two cases had phlebitis, one pneumonia and otitis media. One case had a fæcal fistula. One case required two operations, and one, three before the sinus finally closed.

Letters sent to these 34 cases gave fifteen replies. Twelve cases were well at an average of 6 years, 2 cases were well at one year, and 1 complained of weakness and bad kidneys at the end of one year.

Diagnosis is difficult in the early stages, and in general it may be said that operation is undertaken late. In this group, excluding 2 cases in which the duration of symptoms was 6 months, the average duration was 29 days. In 24 cases a palpable mass, often already pointing, was present. Cystoscopy, ureteral catheterization, and X-ray, although essential in excluding disease of the urinary tract or spine, may be of no positive help in these cases. The three principal points in diagnosis are continued fever, leucocytosis, and abdominal or costovertebral tenderness.

The treatment in general in this series has been simply to drain, reserving further measures for a secondary operation. There were no deaths in the last group of 34 cases. The mortality for 59 cases was 10.2 per cent with no deaths from secondary operations.

To sum up, a very few cases show evidence of a metastatic hæmatogenous infection. Whether this is direct, or indirect either through metastasis in the fibrous capsule, or through rupture of a cortical abscess, is of small clinical importance, provided the possible coexistence of an imperfectly drained renal abscess is borne in mind.

In conclusion, without minimizing the importance of infection of the perirenal fat from a distance through the lymphatics, and without implying the frequent participation of the kidney, I should like to call attention to the following points:

The commonest organism, the staphylococcus, producing "primary" perinephritic abscess is also the most frequent organism concerned in producing focal cortical abscess in the kidney.

"Primary" perinephritic abscess occasionally follows peripheral pus foci. In such cases it is reasonable to suppose that infection has followed a metastatic hæmatogenous course.

A urine normal on clinical examination does not exclude the possibility of cortical renal abscess.

The previous occurrence of a peripheral pus focus due to the staphylococcus may be of some importance in the diagnosis of continued fever with leucocytosis and lumbar or abdominal pain.

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NEW FACTS AND THEIR CLINICAL SIGNIFICANCE CONCERNING CANCER [1]

By WILLIAM CARPENTER MacCARTY, M.D., Rochester, Minnesota
From the Mayo Clinic

IT has been definitely established that the cancer-cell apparently arises in certain organs from cells which are normally present, and have the definite normal function of replacing the functionating cells of the organ (1). They are the immediate offspring of the germinative cells of the parenchyma of these organs.

It has been further established that parenchymal germinative cells of some organs undergo certain morphologic changes in the presence of a chronic irritant or irritants and that these changes are similar in the breast, prostate, skin, and stomach. The line of demarcation between the hyperplastic intra-acinic or intraglandular cellular changes and the extra-acinic or extraglandular epithelial cells which are characteristic of carcinoma is not morphologically visible, the only difference being in the location of the cells; intra-acinic or intraglandular hyperplastic cells have been considered to be non-malignant and extra-acinic and extraglandular hyperplastic epithelial cells to be malignant.

Normal functionating cells, hyperplastic intraglandular and intra-acinic germinative cells and extraglandular and extra-acinic hyperplastic cells of carcinoma are frequently seen in the same field of the microscope (2).

It has been apparent that the most closely related cytologic picture to carcinoma is the intra-acinic or intraglandular hyperplasia, which has been termed secondary epithelial hyperplasia, and that this picture is the histologic condition which should be called the precarcinomatous or precancerous condition (3).

In 1913 I (1) described the stages of epithelial hyperplasia as primary, secondary, and

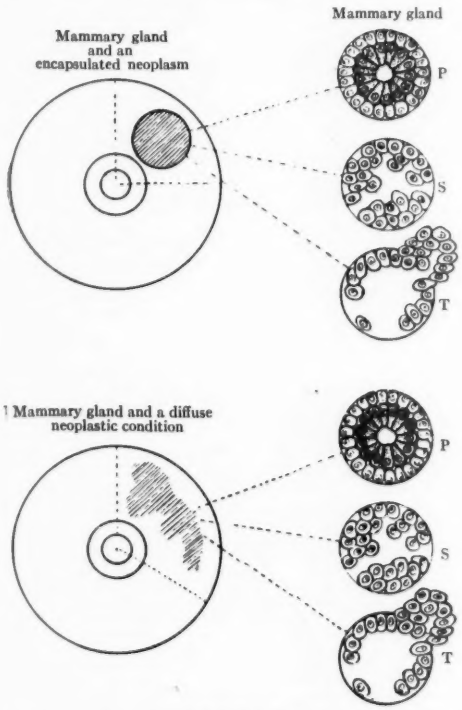

Diagram 1. Encapsulated and diffuse fibro-epithelial neoplasia showing the histologic pictures of primary (P), secondary (S), and tertiary (T) (carcinoma) epithelial hyperplasia.

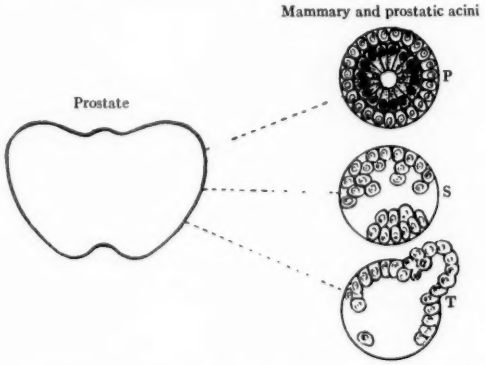

Diagram 2. The prostatic epithelium presents the same arrangement of cells with the same cytologic characteristics which are found in the breast. P, S, T, primary, secondary, and tertiary or migratory hyperplasia.

[1] Read before the Southern Surgical and Gynecological Association, Asheville, North Carolina, December, 1914.

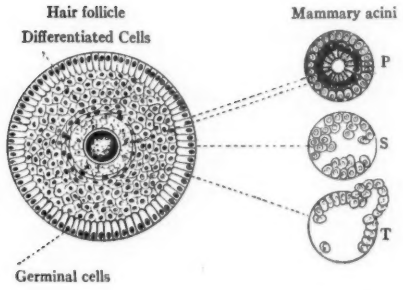

Diagram 3. The principal cytologic changes which occur in the hair follicle in chronic folliculitis are seen in the germinal cells, which present the same cytologic characteristics which are seen in the mammary acini when undergoing a condition of epithelial hyperplasia. P, S, T, primary, secondary, and tertiary or migratory epithelial hyperplasia.

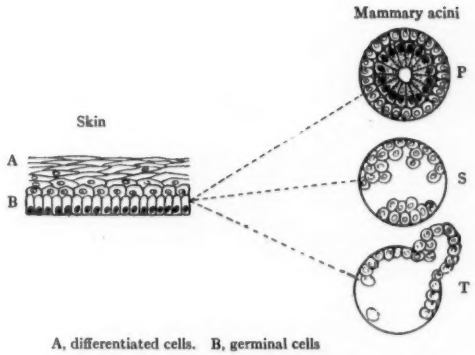

Diagram 4. In conditions of chronic dermatitis one finds the most marked cytologic activity in the germinal layer of cells, which present the same cytologic characteristics which are seen in secondary and tertiary epithelial hyperplasia in the acini of the mammary gland. P, S, T, primary, secondary, and tertiary or migratory epithelial hyperplasia.

tertiary, and during the same year presented (4) an application of these terms to the mammary gland.

Since the terminology which I have adopted as a result of this investigation has proved simple and satisfactory in the case of mammary neoplasms, it has seemed advisable to extend the observations to other organs. The prostate, skin, and stomach have conformed absolutely to this histology and terminology. Such definitely defined terms as primary, secondary, and tertiary epithelial hyperplasia may be utilized in establishing a clearer understanding between the pathologist, clinician, and surgeon in clearly defining benign, doubtful, and malignant epithelial growths. The proposed method, however, involves the undemonstrated danger of spreading a malignant disease by wide excision, both pathologist and surgeon agreeing that incision of neoplasms is a bad and dangerous practice.

In doubtful cases wide excision of pathologic epithelial conditions produces a specimen which may be classified under three distinct and definite headings, each having a definite clinical significance; and that forming the basis of accurately defining the doubtful group of cases, which may be studied with the object of settling the correct operative procedures and the curative effect of operative surgery in its relation to epithelial neoplasms. It may be suggested, therefore, that such a specimen when removed by wide excision be classified as primary epithelial

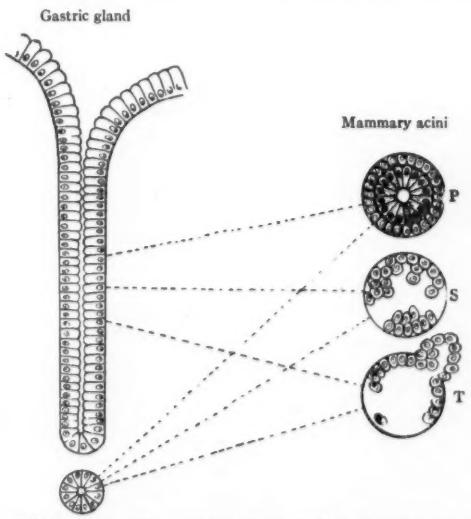

Diagram 5. The analogy between the observations of epithelial hyperplasia in the breast and those in the stomach. The location of the germinal cells in the gastric gland is at present uncertain. In the gastric gland two rows of cells are not seen as in the prostate, breast, skin and hair follicles. However, where the differentiated columnar or cuboidal gastric epithelial cells are normal, one sees in chronic inflammatory conditions certain cytologic pictures which are analogous to those which are seen in secondary and tertiary epithelial hyperplasia in the breast. P, S, T, primary, secondary, and tertiary or migratory epithelial hyperplasia.

hyperplasia, secondary hyperplasia, or tertiary hyperplasia, the first being benign, the second being doubtful, and the third being malignant. (See diagrams 1, 2, 3, 4, and 5.) With our present knowledge the first condition requires only excision if anything, the second wide excision, and the third complete or radical removal.

In case the pathologist reports secondary hyperplasia, wide excision only is justifiable. It is this group which needs careful study because the exact outcome of such a condition can only be accurately determined by the post-operative histories of such cases. This fact puts the problem in a field of research which belongs to the surgeon and forces him to standardize his operative procedures to histologic findings. Only by such standardization will the clinician, the surgeon, and the surgical pathologist be able to coöperate scientifically in their efforts to render justice to the patient.

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TRAUMA INTO AND ABOUT JOINTS[1]

By C. E. CALDWELL, A.M., M.D., Cincinnati, Ohio
Associate Professor of Surgery, Medical Department, University of Cincinnati; Surgeon, Cincinnati General Hospital

At the risk of being too discursive, I have chosen the above title for my paper, as I wished to discuss certain features of joint injuries which have presented themselves in my own private and hospital practice. In some instances I have been able to arrive at definite conclusions as to the best methods of procedure; in others I am still left in doubt.

Whether one should or should not resort to operative interference in a given case of injury in the neighborhood of a joint is and will always be a matter of individual judgment, based on the results of individual experience in the treatment of that particular type of injury. It will prove difficult to standardize surgical skill, and the ordinary mortal can hardly hope to vie with the brilliant achievements of exceptionally gifted colleagues.

At the shoulder-joint, a problem frequently presented for solution is the treatment of fracture-dislocations. Conclusions will be best reached by a discussion of the altered anatomical conditions and the manner in which they have been produced. It may be assumed that when fracture at or near the anatomical neck of the humerus complicates a dislocation, force, in addition to that concerned in the production of the dislocation, has been more or less directly exerted at the point of fracture. To me the most plausible explanation is the following:

The patient falls with outstretched or abducted arm, and when the fall does not result in a Colles' fracture the force is transmitted through the rigid forearm and arm against the lower margin of the glenoid, against which it is held in closer contact by the contraction of the pectoralis, latissimus dorsi, and deltoid muscles. The force of the impact separates the head at the anatomical neck, and the line of cleavage may or may not include the greater tuberosity as a whole, or in part, with its facets of insertion for the supraspinatus, infraspinatus, and teres minor muscles.

Simultaneously with the separation of the head and the resulting tearing of the capsule, the shaft is pulled medianward by the pectoral and latissimus dorsi, and the head of the bone, should the line of cleavage have

[1] Read before the Southern Surgical and Gynecological Association, Asheville, North Carolina, December 17, 1914.

included the insertion of these muscles, will be pulled upward and rotated outward by the contraction of the supraspinatus, infraspinatus, and teres minor muscles. This outward rotation of the head is shown in Fig. 1, and when it is present it will be impossible, I believe, to reduce the head without operative interference.

Where the head has passed the margin of the glenoid toward a subglenoid or a subcoracoid luxation, or when simultaneously with such passage the tuberosity is avulsed, or what in its effect upon the head amounts to the same thing, that is, the line of cleavage is entirely through the anatomical neck, the head will remain unrotated either in the subglenoid position or subcoracoid, having been pushed into this position by the end of the shaft as it travels inward following the pull of the pectoral and latissimus dorsi muscles. In this position there may be a chance to effect reduction by pressure on the head through the axilla, traction and abduction of the arm being practiced by an assistant with the patient completely narcotized. The greatest care, however, must be exercised to avoid further damage to already contused vessels and nerves. In the face of the enormous extravasation present in some cases, such precautions are more readily advised than observed.

In case interference proves necessary, I am more and more inclined to advocate operation as soon as the diagnosis has been made, and the futility of efforts to reduce has been demonstrated. I am not disposed to believe that there is one-half the danger of infection through freshly torn tissues that is present in tissue subjected to the devitalizing effect of pressure, and the toxic effect of blood ferments. If wait we must, let us wait until the tissues have regained their normal tone and the possibilities of effective arthroplasty are greater.

Fig. 1. Fracture dislocation of the head of the humerus. Note external rotation of the head.

Even so early as a week after injury, the difficulty of reducing the head may prove insurmountable, and the removal of the head is the only thing left to do: a most regrettable alternative. In several instances — in two at least — where I have been forced to remove the head, after prolonged efforts to

Fig. 2. Fracture dislocation of head of humerus. Arrow points to subcoracoid position of the head.

Fig. 3. Fracture dislocation of the head of the humerus. Note subglenoid position of the head.

Fig. 4. Same as Fig. 3, after removal of head of humerus.

Fig. 5. Rotation and subacromion position of head of humerus.

Fig. 6. Same as Fig. 5, after removal of head of humerus.

Fig. 7. Fracture of surgical neck in patient aged 62; condition precluded operation.

effect a reduction, I feel that there was much left to be desired in the usefulness of the arm. How long this disability will last I am unable to state. It is in part attributable to a lack of a sufficient fulcrum at the upper end of the humerus, the absence of a *point d'appui* for the supraspinatus, infraspinatus, and teres minor muscles, and also in part to conditions which obtain even after simple luxations of the shoulder; i.e., lacerations or paralysis of branches of the brachial plexus, principally the circumflex nerve which winds around the surgical neck of the humerus in the most favorable position to be stretched or torn.

The danger of disability from this last-mentioned source, even in simple dislocations, should be anticipated, and the patient prepared for such an event should it occur. We should always remember that results which are not satisfactory to the patient do not admit of *post facto* explanations. Patients are often more fair and reasonable than we from our prejudiced standpoint are willing to admit, and a timely setting forth of the possibilities in a given case may prevent much justifiable hard feeling where results do not measure up with expectations.

As to the viability of the head in cases

Fig. 8.

Fig. 9.

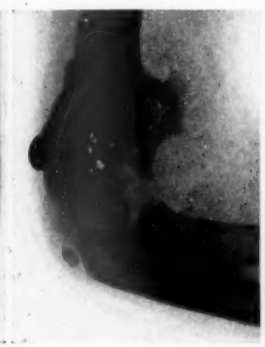

Fig. 10.

Fig. 11.

Fig. 8. M. M., age 9. Profile view day after injury. Note comminution and obliquity of line of fracture.

Fig. 9. M. M., age 9. Anteroposterior view of elbow, day after injury. Note internal displacement of arm.

Fig. 10. M. M., age 9. Profile view of elbow, two months after plating. Note bony overgrowth from torn periosteum, which is fast disappearing. Result, almost perfect function.

Fig. 11. M. M., age 9. Anteroposterior view of elbow, two months after plating. Note oblique position of plate to avoid bridging the olecranon fossa. Also slight projection over lower end.

Fig. 12. O. S., age 62. Comminuted fracture at elbow treated by reduction of fragments under anæsthesia and extreme flexion. Result excellent.

Fig. 13. O. S., age 62. Showing good position of fragments in a comminuted supracondylar fracture, by extreme flexion of the elbow. Functional result excellent.

Fig. 14. Compound comminuted fracture of humerus and ulna. Fragments removed at operation. Pocket of pus found. Result, stiff elbow.

where it is preserved, personally I am inclined to believe that were skiagrams taken, not six months, but two years after the accident, we should find in many instances atrophy or even complete disappearance of the head. The observations on which such an opinion is based are not sufficiently numerous to be convincing, but time and a sufficient number of observations will demonstrate the correctness or fallacy of the opinion.

The above remarks apply only to fractures through the anatomical neck. The cutting off of the blood and nerve supply in these cases makes it particularly desirable that replacement should follow as closely as possible upon the injury in order that the blood supply may, if possible, be restored. A fragment of bone once completely detached from the blood and nerve supply is unlikely to preserve its vitality for long. Especially is this true when, as in the case of the detached head of the humerus at the anatomical neck, there is no periosteum to help it out. I am not ignorant of much of the literature on bone-transplants, but fail to be convinced, by much of the evidence, of the permanent vitality of these transplants. Because certain epithelial structures continue to grow after death is no argument for the permanence of their vitality.

In one case I removed the head, which proved to be a mere concavoconvex lens of bone which was too fragile to admit of nailing to the shaft.

Where the head can be reduced, sometimes mere suturing of torn periosteum suffices to hold it in place.

In spite of the most rigid asepsis in effecting reduction, it is perhaps asking too much to expect as free mobility in the shoulder as before the injury, and it is difficult to fix the scapula so as to determine accurately the arc of mobility; but if for all practical purposes the range of movement is satisfactory to the patient, we may feel gratified by the result.

Chipping of the edge of the glenoid sometimes further complicates these cases. The best remedy for this is removal of the fragment. Uncomplicated fracture or avulsion of the greater tuberosity of the humerus has not in my experience required operative interference, although I am aware that it is the custom of not a few surgeons to fix them with nails or otherwise.

I have never found it necessary to operate in simple fractures of the surgical or anatomical neck, although I am aware that such operations are not infrequently advisable.

In fractures about the elbow-joint, we must distinguish sharply between those occurring in adults and in children. In children, hardly any fracture is so severe as not to offer hope of an ultimately satisfactory result

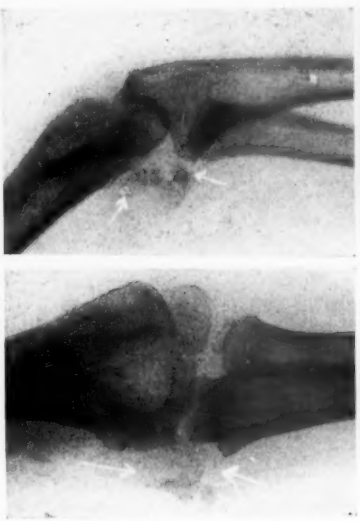

Fig. 15. Fracture of internal epicondyle, external condyle, and tip of coronoid process of ulna.

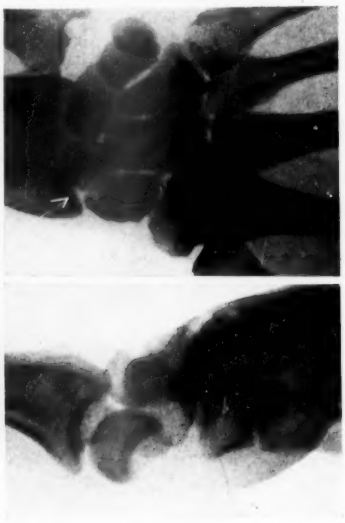

Fig. 16. Dislocation of semilunar bone of carpus. Attempts to reduce before and after operation. Bone removed. Result excellent.

as far as function is concerned. Ankylosis is a remote contingency, and so far as *bête noire* gun-stock deformity is concerned, it may in most instances be avoided by overflexion of the forearm on the arm.

In one instance only have I been obliged to resort to open operation to correct conditions which must inevitably have resulted in a crippled arm. This case is of sufficient interest to merit more detailed description.

M. M., girl, age 9, in sliding down banisters, fell, striking her elbow with great violence on a hardwood floor. On examination, within a half-hour after the accident, the arm presented an immensely swollen and distorted appearance. Examination under chloroform discovered a badly comminuted supracondylar fracture, with great lateral displacement of the fragments. Flexion of the forearm on the arm resulted in wider displacement of the fragments. The arm was therefore supported in an extended position on a posterior splint and an ice-bag placed in contact with the elbow.

The following day I requested Dr. Sidney Lange to bring a portable X-ray machine to the house, and as a result of the findings in the pictures advised the removal of the patient to a hospital as soon as the condition of the arm would permit of operation. I was actuated in this case by motives of expediency, as I was not satisfied that the soft tissues were in a condition to resist the slightest infection. Should I have another such case, I am sure I should advise immediate operation. I believe that the difficulties encountered would have been minimized by such a course.

Eight days after the accident I operated, and found the difficulty in reduction such that I was obliged to make a much larger incision than I wished to make for cosmetic reasons.

The difficulties of adjustment were increased by a rigid adherence to the rule of permitting nothing to come in contact with the wound but instruments and gauze on holders. The nurses were instructed, and obeyed the instruction, to pick up the needles and thread them with forceps. A small three-holed vanadium steel plate was used to fasten the main fragment, and catgut sutures to hold the others in place by suturing the torn periosteum. It was exceedingly difficult to place the plate, as may be seen by Fig. 9, so as to avoid bridging the olecranon fossa. This was finally accomplished by turning the plate obliquely. This obliquity of the plate has caused a slight elevation of the skin at the outer side of the elbow, which, if in later years is any source of annoyance to the young lady, may be eliminated by removal of the plate.

The wound was closed with Michel clips, the marks of which at the present writing, six months after the operation, have about disappeared. The patient has almost complete extension and flexion of the arm, and perfect rotation. An obstacle to complete flexion exists in a bony overgrowth from

torn periosteum on the anterior surface of the humerus underneath the branchialis anticus. This is noticeably smaller than at first, and I am confident in time will entirely disappear.

In adults when the elbow shows great comminution, and the fragments are so disposed after attempts at reduction that they will inevitably interfere with function, it is obviously our duty to operate, and clear away such wreckage as cannot be made to serve a useful purpose in the reconstruction of the joint. While in most instances it will not be possible to secure even an approximately perfect function, we shall at least give the patient the best chance for it. A myositis ossificans developing in the proximity of the injured joint may exceptionally jeopardize the chances of a complete recovery of function.

Olecranon fractures, when not well approximated in extension, may require wiring or plating, or perhaps nothing further than suturing of the fibrous expansion of the extensor cubiti.

In the wrist I have come across a case of complete dislocation of the semilunar bone which, after repeated attempts to reduce before and after opening the wrist, I was obliged to remove, with perfect functional result.

At the ankle I have been obliged to plate only twice, it being impossible to bring the displaced lower fragment of the tibia into line. Ordinarily I have found the varus position of the feet with adhesive strapping most effective in reducing the displaced lower fragment of the tibia.

I have come across uncomplicated fracture-dislocation of the astragalus only once. The

Fig. 17. Fig. 18.

Fig. 17 Compound comminuted fracture of tibia, result of motorcycle accident. Crushed the leg between machine and water trough. Conservative treatment. Patient discharged with good functional result in thirty-two days.

Fig. 18. Profile view of case of comminuted fracture of tibia, victim of motorcycle accident.

Fig. 19. Fig. 20. Fig. 21.

Fig. 19. Linear fracture of tibia into joint. A fracture easily overlooked. Showing the advisability of skiagraphing when possible since fracture would almost surely be overlooked otherwise.

Fig. 20. Exaggerated Pott's, including more than the internal malleolus. Good reposition obtained by treating same in the varus position.

Fig. 21. Fracture dislocation of astragalus. Attempts to reduce under anæsthesia failed. Failure to reduce at operation. Astragalus removed. Result good.

pressure from the inner fragment threatened sloughing of the skin below the internal malleolus. All efforts to reduce under anæsthesia had failed. The bone was removed, and patient made a good recovery.

Occasionally, as the result of fractures into the knee-joint, one or another of the tuberosities of the tibia become markedly displaced, thus altering the weight-bearing surface of the tibia. In one such case I reduced and nailed the outer tuberosity, with an excellent functional result.

Displaced condyles of the femur are exceedingly difficult to manage, whether with or without operation. In heavily muscled individuals this is especially true. I was unfortunate enough to get a deep infection in a case of compound fracture in which the first-aid surgeon had neatly sewed up an infected skin wound. Fortunately it was sufficiently anticipated, and the patient made a slow but good recovery after the removal of the plate.

Such an experience makes one alive to the occasional dangers which beset the path of the too promiscuous and enthusiastic bone-plater. In many instances, treatment by extension and the double inclined plane, will secure a sufficiently accurate coaptation of the fragments to give the patient a good functional result.

I have not recently come across any fractures or avulsions of the tibial spines. In answer to the query of Mr. Jones, of Liverpool, as to whether we in America are not overlooking these cases, I may answer that we could not fail to see them in a good skiagram, and we skiagraph all our knee cases. It is not impossible that cricket, sprinting, and other outdoor sports more universally engaged in in England and her colonies, may have contributed to Mr. Jones' unusual experience with this injury. Again, very few are fortunate enough to have the enormous material that is at Mr. Jones' disposal.

As intimated at the outset, this subject has been treated rather discursively, but my object was to jot down only a few personal observations and to invite general discussion for better enlightenment.

DIAGNOSIS OF ENTEROLITHS BY MEANS OF RÖNTGEN RAYS[1]

With the Report of Two Cases

By G. E. PFAHLER, M.D., and C. J. STAMM, M.D., Philadelphia

CLINICAL EVIDENCE

By C. J. Stamm.

AT the very beginning I might say that there is very little literature upon this subject; in fact, but ten cases have been reported, of which only one had been diagnosed before operation. This was discovered accidentally by Weisflog[2] in 1906, who while searching for a ureteral stone by means of the röntgen rays found two stones in the appendix.

The symptoms in all of these cases correspond fairly well: pain at the site of the enterolith; intestinal disturbance, as nausea, vomiting, and diarrhœa. The pain was usually exaggerated after the taking of food.

In the case reported by W. J. Hearn[3] (1904) there was subacute intestinal obstruction due to a stone in the small intestines. The bowels moved, but nausea and vomiting were present. The stone was removed at operation, though not previously suspected.

J. M. Spellissy[4] in 1906 reported a case operated upon with G. G. Davis in 1903 when a hardened mass was removed extraperitoneally through an incision close to and below the anterior superior spine. A sinus remained, and five months later Davis found the sinus communicating with the appendix. The sinus and appendix were removed and the wound closed.

[2] Weisflog. Fortsch. a. d. Geb. d. Röntgen, Hamburg, 1906, x, 217.

[3] Hearn, W. J. Tr. Phila. Acad. of Surg., 1904, vi, 166.

[4] Spellisy, J. M. Ann. Surg., Phila., 1906, xliii, 767.

[1] Read before the Section on General Medicine of the College of Physicians of Philadelphia, February 26, 1915.

Wimmer [1] and Passini [2] in 1907, each reported one case; Zulawski [3] one in 1909, MacHardy [4] in 1910 and Graeve [5] reported three cases in 1910.

In the cases reported by Spellissy, Wimmer, and MacHardy a palpable mass had been previously found.

The first case that we have to report has the following history:

Mrs. F. on March 24, 1912, complained of soreness in the right inguinal region, and in her endeavor to locate the pain found a rounded, freely movable mass, the size of an egg, in the right iliac region, tender to touch. A physician was called, a surgeon also in consultation, and operation was advised. This the patient refused.

I saw her that night. Examination by vagina and rectum failed to reveal anything abnormal. Abdominal palpation revealed a large, rounded, freely movable mass in the right iliac region; mass tender to touch.

X-ray examination was advised, believing that we had to eliminate movable kidney, tumor of the kidney, as well as stone in the ureter. After a thorough examination by Dr. Pfahler he determined that the mass was an enterolith. I might say in passing that the patient had had chronic constipation since childhood, and that during the two years immediately preceding this attack she had taken from one to two ounces of milk of magnesia daily to overcome the constipation.

The treatment in this case consisted of abdominal massage, glycerine and olive oil enemata taken twice daily in the knee-chest position. On June 3, 1912, I removed the enterolith piecemeal from the rectum, as she could not expel it spontaneously. During the entire time that treatment was being instituted the only symptoms present were soreness and tenderness in the right iliac region. These have since disappeared.

RÖNTGENOLOGICAL EVIDENCE

By G. E. Pfahler

In the past, enteroliths have generally been found at operation or autopsy. Until recently a clinician could not do more than suspect them. Today, if they are suspected and a careful röntgen examination is made, they should be demonstrated, or if a thorough röntgen study is made they should be found even when not previously suspected.

Enteroliths in the vermiform appendix have been found accidentally during a röntgen examination for stone in the ureter, but the only instance in which I find a definite report of such a case is by Weisflog.[6] He found two stones occupying the region of the appendix, which were movable. The patient suffered from some symptoms of chronic appendicitis. After operation, an analysis of the stones by Vogt showed them to consist of sodium phosphate, traces of iron, a small proportion of calcium carbonate, and mostly calcium of phosphates. These stones are very dense, and in this respect resemble very strongly urinary calculi.

Fig. 1. Shows enterolith on the right side of the pelvis, near the brim. Other plates showed this body lying over the ilium, then above the brim of the pelvis, and finally, by bismuth injection, was shown to be in the cæcum.

Enteroliths in the appendix must be differentiated from:

1. Phleboliths which are so often found in the pelvis. These are round, are most often found in the neighborhood of the spine of the ischium, are generally less dense in the center, have smooth and even surfaces, are often multiple and not infrequently found on both sides. The enterolith would be confusing only when it is small and located deep in the pelvis. I believe all appendiceal enteroliths are irregular or rough in outline, are less likely to be fixed and do not occupy the same plane as phleboliths.

[1] Wimmer, H. München. med. Wchnschr; 1907, liv, 1032.
[2] Passini, R. Riv. Med., Milano, 1907, xv, 109.
[3] Zulawski. Przegl. Lek., Krakow. 1909, xlviii, 121.
[4] MacHardy, T. Edinb. M. J. 1910, n. s. iv, 439.
[5] Graeve. Upsala Läkäref. Förh., 1910, n. s. xv, 488.
[6] Weisflog. Fortschr. a. d. Geb. d. Röntgen., Hamburg, 1906, x, 217.

Fig. 2. Enteroliths in the appendix found during an examination for supposed ureteral calculi. By bismuth injection this was proved to be in the appendix.

2. Calcified glands. These are more likely to occupy a position near the spinal column, and to be located in a deeper plane in the tissues.

3. Genuine enteroliths in the bowel. These are rare, and likely to be larger. They are also less dense, and usually spherical.

4. Gall-stones. These are likely to be less dense, and if located low in the abdomen are likely to be more movable. They also usually show a less dense center.

5. Ureteral stones. These will be the most confusing, because it is usually during a kidney and ureter examination that the appendiceal enteroliths are found. They can be differentiated by passing an opaque catheter into the ureter. They are also likely to be smaller in size and occur in line with the ureter. The ureter is only rarely displaced outward.

6. Foreign bodies, such as are swallowed by children or the feeble-minded. Their shape and density will usually serve to differentiate.

Finally, the enterolith can be definitely differentiated, when suspected, by cleansing the bowel, then giving an opaque enema, filling the bowel and the appendix, and surrounding the enterolith with the opaque mixture.

True enteroliths occupying the bowel are more rare, and, so far as I can determine, the case we report is the first to be recognized and definitely diagnosed. It is also the first to be removed without operation.

By personal communication I have learned of another case more recently diagnosed by LeWald of New York, and I am indebted to him for the privilege of showing his lantern slides with mine. This case will be reported in detail later.

She was a girl 12 years of age, had been constipated for years, and a peculiar oozing from the rectum caused annoyance by soiling the clothing.

By palpation, a mass was detected in the abdomen suspected of being a movable kidney, tuberculosis, lymph-node, or a new growth. A röntgenographic examination of the urinary tract was negative. A bismuth meal study showed an elongated sigmoid flexure at the seventy-second hour. A cleansing enema was given, after which a röntgenogram showed a large globular mass two and one-quarter inches in diameter. The mass was removed by Dr. Hollis by rectal instrumentation.

In this case the enterolith was evidently rendered opaque by a deposit of bismuth from the bismuth meal. It probably could have been diagnosed at once by means of an opaque enema, in which instance it would have shown a filling defect.

Enteroliths within the bowel seem to be rare. They reach a considerable size, are globular in shape, are movable, and I believe generally would be only slightly more dense than fæcal matter. They must be differentiated from—

1. Movable kidney. In both of the above cases this was the supposed diagnosis. A kidney shadow can usually be shown, is not globular in outline, and of course does not occupy the lumen of the bowel, as could be demonstrated by opaque enema, or injection of the colon with air.

2. New growths. These are not likely to be globular, nor movable, and if they occupy the bowel are apt to show characteristic serrations.

3. Gall-stones. Large gall-stones might be most confusing, as is shown in one of my studies. By means of a bismuth meal, or an opaque enema, it is likely, however, that these can be shown to lie outside of the bowel, as was demonstrated in a case of mine.

CASE REPORTS

CASE 1. Mrs. F., age 40, had suffered from intestinal disturbances, chiefly associated with constipation, for years. She had been suffering from abdominal pain of a general character for a week, when one of us (Dr. Stamm) was called, and by palpation a movable mass was found which was thought to be movable kidney.

A röntgen study was begun March 25, 1912. An examination of the urinary tract showed the kidneys normal in size, shape, and position, and also showed an abnormal mass only slightly opaque, about one and one-half inches in diameter, occupying the pelvis, and then the iliac region.

This was suspected of being an enterolith. I first injected the colon with air, with the hope of more clearly outlining this mass within the lumen. This was a failure, I believe, because of an unsatisfactory fluoroscopic table; though the patient was stout. Injection of the colon with an opaque enema definitely showed this mass to occupy the cæcum. It moved both with the cæcum and within the ascending colon.

By means of glycerine enemata and manipulation this enterolith was partially dissolved and moved into the rectum, where it was broken by the finger and removed by Dr. Stamm.

The following is a report of the chemical examination of the enterolith made by Professor George H. Meeker of the Department of Chemistry of the Medico-Chirurgical College:

The enterolith consists mainly of magnesium phosphate. In addition to the magnesium phosphate the following substances were also identified: calcium phosphate, fats, traces of iron, minute seeds (possibly from the fig) and indefinite organic matter.

This case is of interest because it is probably the first which was definitely diagnosed and the enterolith removed from the cæcal region without operation. It is also of interest as an illustration of the methods by which such and similar affections can be definitely diagnosed.

CASE 2. Miss C., age 42, was referred by Dr. LaPlace for röntgen study February 10, 1914. For three or four years she had been suffering from

Fig. 3. Shows a gall-stone lying partially over the shadow of the bowel and partially above it, at the hepatic flexure. This body was found to move around to a considerable extent, and finally was proved to be outside the bowel by the opaque enema.

headache and nausea. The attacks came on every seven to ten days, lasted about twenty-four hours, and were relieved by vomiting. She had constant pain in the left lumbar region. At times she was tender over the appendix and at times became jaundiced.

Röntgen examination showed two opaque bodies in the right iliac fossa, about two inches outside of the usual position of the right ureter. Injection of the colon showed the bismuth surrounding these bodies in the appendix. They were removed by Dr. LaPlace.

CONCLUSIONS

1. Enteroliths should be suspected when there is a movable mass in the abdomen, or when opaque bodies are found in the appendiceal region during the course of a röntgen examination of the ureters.

2. They can be definitely demonstrated by filling the colon with gas, or better by filling it with an opaque enema and demonstrating the mass within the lumen of the bowel.

3. By means of glycerine enemata and manipulation these enteroliths in the bowel can probably be removed without operation.

A NEW METHOD OF SECURING BONY ANKYLOSIS OF THE SPINE IN POTT'S DISEASE BY MEANS OF A BONE TRANSPLANT

By ALBERT E. HALSTEAD, M.D., F.A.C.S., Chicago

FIRST STEP: With the patient in the lateral prone position, an incision beginning on the median line above the kyphos is curved around this prominence and terminates below at the median line. A flap of skin and fascia is reflected back to the spinous processes (Fig. 1).

Second step: An incision is made along the lateral aspects of the tips of the spinous processes and extended for a distance of two vertebræ above and two below the diseased vertebræ. With a sharp chisel the soft tissues, including periosteum and the erector spinæ muscles, are separated from the lateral surfaces of the spinous processes well down to the vertebral arch (Fig. 2).

Third step: After retracting outward, the tissue is separated from the spinous processes, the spines are sawed through at their bases, one above and one below the kyphosis, as indicated in Fig. 3.

Fourth step: The severed spinous processes, with the connecting ligaments, are strongly retracted to one side and away from the bases. The prominent bases of the spinous processes at the apex of the kyphos are cut away with a chisel (Fig. 4).

Fifth step: A bone transplant is removed from the tibia in the usual way. The transplant is of sufficient length to reach from at least one vertebra above the diseased bones to one below. It is also fashioned so that it will have periosteum on one lateral surface and on one border. From the lateral surface the periosteum is reflected back to the border to which the periosteum is attached. The transplant may be held secure in a small vise

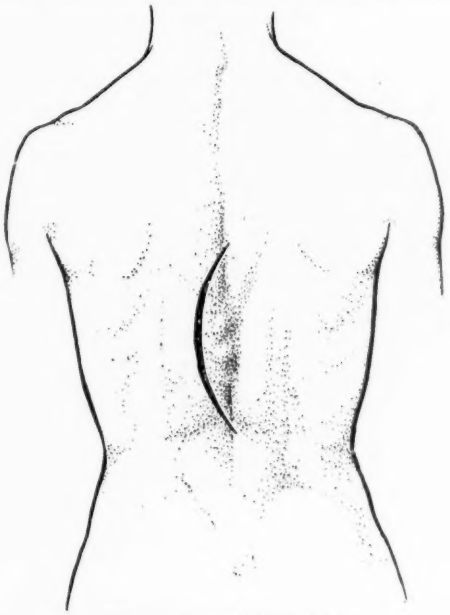

Fig. 1. Curved skin incision.

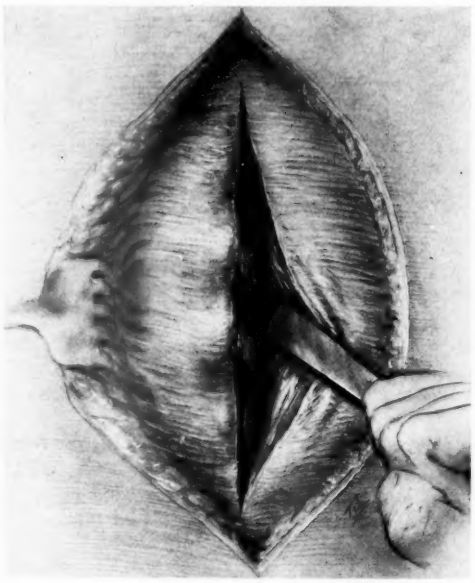

Fig. 2. Skin flap reflected; straight incision over the spinous processes; separation of periosteum and muscles from the sides of the spinous processes by means of a chisel.

Fig. 3 Periosteum and muscles retracted; electric saw used to cut through the bases of the spinous processes.

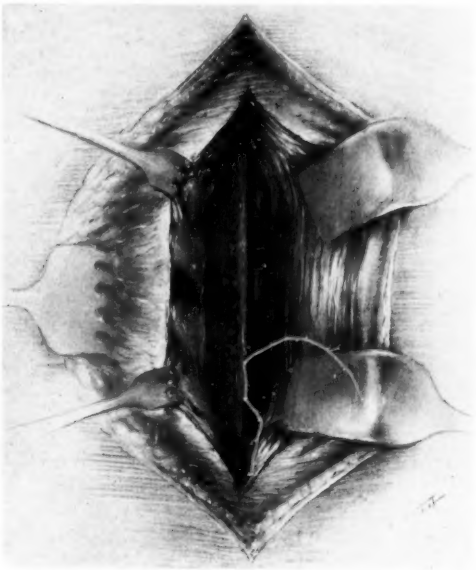

Fig. 5. Transplant with free border covered by periosteum is inserted between cut ends of spines.

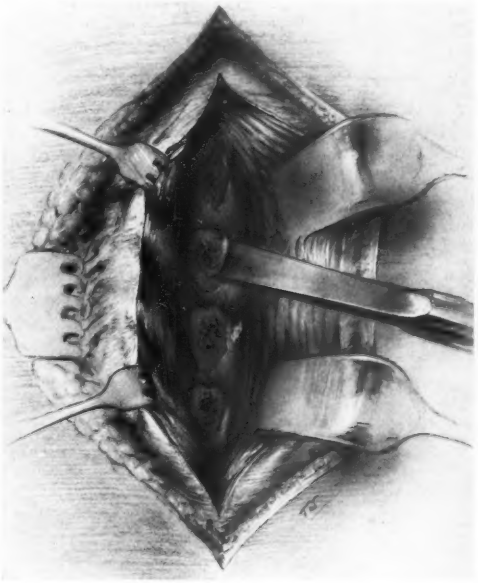

Fig. 4. Flap containing spinous processes and their connecting ligaments retracted, showing cut bases of spines; the most prominent are being cut down with chisel.

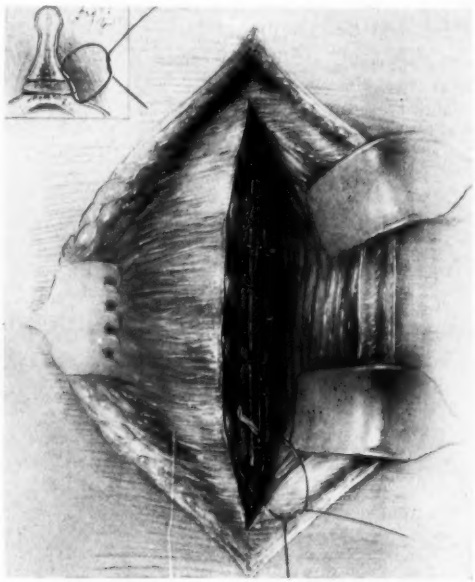

Fig. 6. *A*, Flap replaced. *B*, Transplant held by chromic sutures passed through periosteum of spinous processes, of transplant, and periosteum and muscles at base of spines.

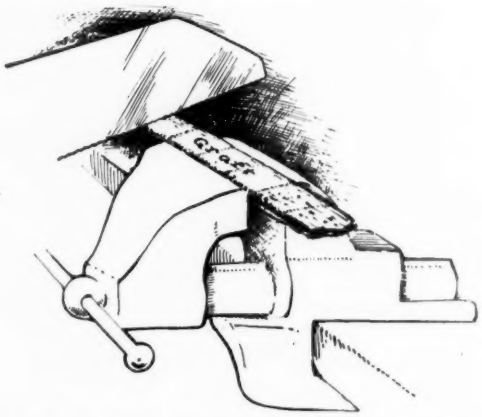

Fig. 7. Method of preparing transplant. Note the small vise used to hold bone transplant while it is being shaped to suit conditions that are presented.

while it is cut to meet the requirements of the case.

The patient is now placed in the prone position and the transplant inserted between the cut surfaces of the divided spinous processes. The border of the transplant to which the periosteum is attached is toward the side from which the soft tissues have been retracted (Fig. 5).

The transplant is held in place by replacing the retracted, detached spinous process, and secured by passing heavy chromicized catgut sutures through the periosteum of the detached spinous process, the periosteum of the free margin of the transplant, and then through the periosteum at the base of the spinous process (Fig. 6).

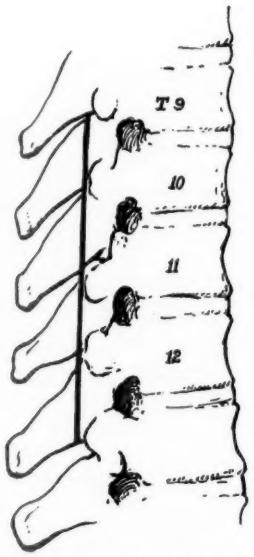

Fig. 8. Schematic drawing showing method of placing bone transplant.

The deeper portions of the wound are closed by buried catgut sutures, and the skin by silkworm-gut sutures.

The spine is immobilized by means of a plaster-of-Paris molded splint for ten weeks.

SPLENECTOMY FOR HÆMOLYTIC ICTERUS[1]

A Discussion of the Familial and Acquired Types with a Report of Splenectomized Cases

MEDICAL REPORT AND DISCUSSION

By CHARLES A. ELLIOTT, M.D., Chicago

SURGICAL CONSIDERATIONS

By ALLEN B. KANAVEL, M.D., Chicago

On account of the general interest that has of late centered around splenectomy as a curative agent in certain diseases, notably pernicious anæmia, biliary cirrhosis, Banti's disease, and hæmolytic icterus, and on account of the total absence in the American literature of case reports of splenectomy for hæmolytic icterus, we venture to report such a case as well as our conclusions resulting from the observation of a number of cases of this interesting affection.

We have observed three of a family showing the more severe manifestations of this disease, removing the spleen from one of these; four of a family presenting the less severe manifestations (Gilbert type), and one case of acquired hæmolytic icterus.

Case 1. (A. M. B., family icterus, splenectomy.) Wesley Hospital, No. 52,418. Our principal interest centers about the case from whom the spleen was removed, a clergyman of 54 years, who has suffered from attacks of illness associated with jaundice since 14 years of age. These attacks have been variously diagnosed — malaria for the most part, although there is only the most superficial resemblance to malaria suggested by the history or clinical findings.

The attacks (acholuric crises) have been very similar in their manifestations, as related by the patient, the first occurring at the age of 14, at which time he had a short febrile attack associated with jaundice, which lasted about two weeks. At twenty he had "chills and fever" with jaundice, which continued all one fall. At 33, while a student at Evanston, he had a febrile attack with malaise and much aching of the muscles, associated with deep jaundice. The jaundice continued intense for some two years, and he has never been entirely free from icterus of some grade since that time, some 21 years.

During this period he has been subject to recurrences of these attacks (acholuric crises), each of a few days duration, at first recurring at intervals of months, but of late recurring about every two weeks and becoming more intense in their manifestations. These crises are similar, although variable as to intensity and duration. At onset the patient notices a general feeling of unrest, malaise, and lassitude. There is headache and aching in the muscles, with some tenderness in the upper abdomen, and a deepening jaundice. There may be fever, and of late he has noticed that the splenic tumor has become larger, standing up prominently in the abdomen during the acute attack. The urine is dark — a mahogany brown — and the stools are occasionally acholic, although not usually altered in appearance.

Aside from slight abdominal tenderness there has been no abdominal pain. His appetite has been good and digestion apparently perfect. There have been no stomach symptoms or signs of cholæmia, such as pruritis and bradycardia, and the patient continues in a fair state of nutrition. Aside from an occasional nose-bleed there have been no hæmorrhages.

In January, 1914, an entirely different attack set in. This was heralded by gastric phenomena, loss of appetite, vomiting, and severe pain in the upper abdomen. He had chills and fever, with much tenderness in the gall-bladder region. This continued for about a month, at which time a laparotomy was performed and a gangrenous gall-bladder removed containing four pigment stones. The operation was performed as rapidly as possible without exploring the common duct.

One month after the operation there was a recurrence of the acholuric crises, without pain, but with much jaundice. The spleen was noticed to be very large and became much swollen with each attack. Some of the more severe attacks were ushered in with dizziness and threatened unconsciousness, and were evidently becoming more severe in intensity. Ankle œdema has been present during the height of recent attacks. There was much malaise and the patient was totally incapacitated for all forms of work.

Upon examination he appeared anæmic and markedly jaundiced, of a light lemon color, but there was no evidence of cholæmia. The spleen extended some 20 cm. below the costal margin, was firm and painless, and presented a systolic murmur at the rib edge. It reminded one of a moderate leukæmic spleen. The liver was distinctly palpable, edge two fingers below the costal margin, with

[1] Read before the American Surgical Association, Rochester, Minnesota, June 8, 1915.

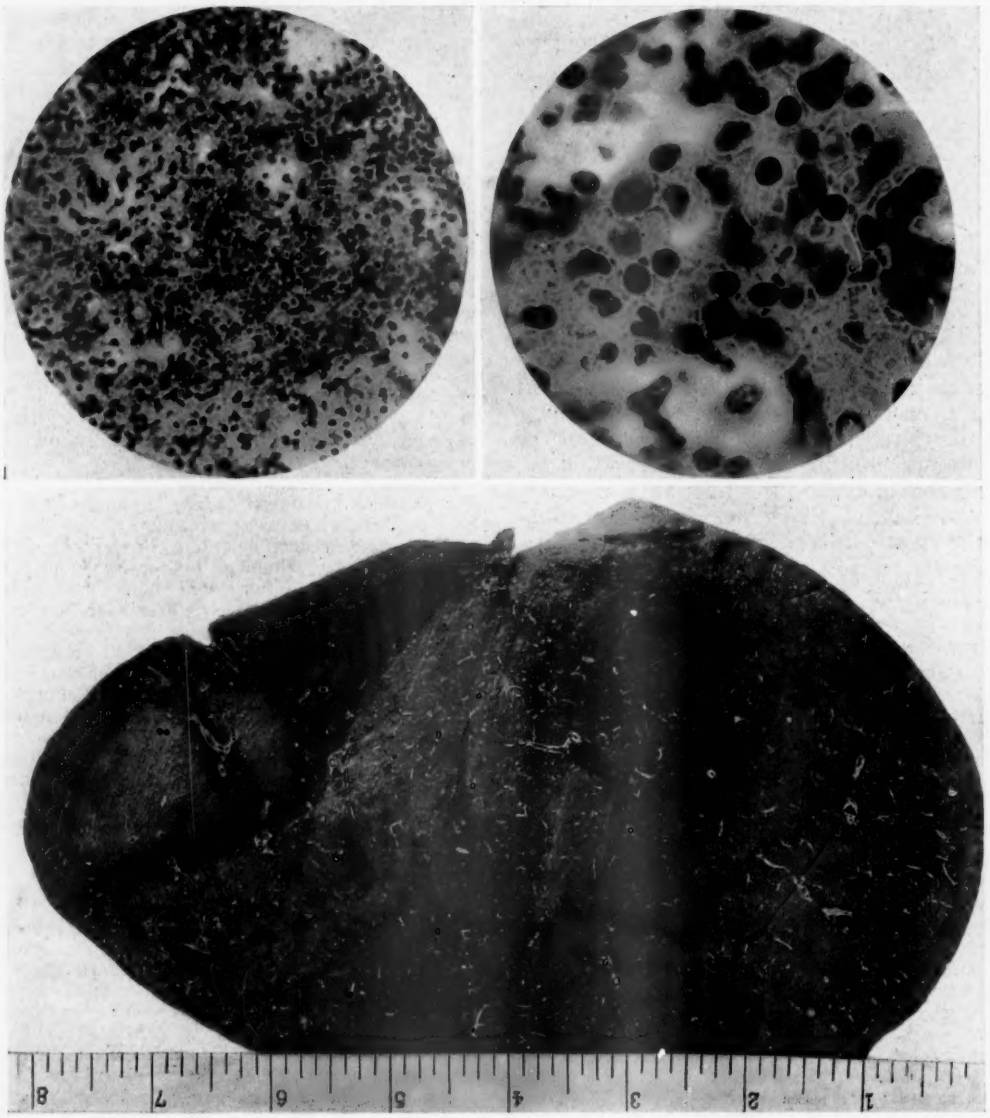

Fig. 1. Cross section of spleen, with microscopic sections. The dark colored area in the gross specimen is due to fixation and is of no pathological importance.

a well-marked right lobe extending well into the flank. It was only slightly tender upon palpation. The blood averaged, 4,000,000 red cells, 4,500 white cells, and 70 per cent hæmoglobin. Coagulation time 3.25 minutes. There were no nucleated reds or polychromatophilia. The stained smear reminded one of a moderate secondary anæmia and had none of the characteristics of pernicious anæmia. The Wassermann test upon the blood was negative; urine negative; blood-pressure 128–78.

A fragility test of the red cells showed that they were less resistant to hypotonic salt solutions than normal, hæmolysis beginning at 0.52 per cent and complete at 0.36 per cent sodium-chloride solution, the normal beginning at about 0.44 per cent and complete at 0.28 per cent.

Upon the seventh day in the hospital one of the acholuric crises occurred. He complained of lassitude, slight headache, and some tenderness in the liver region. The jaundice became markedly more intense and the spleen much swollen, standing erect in the abdomen to three fingers below the level of the navel. There was no fever nor an increase in the white cell count. A duodenal tube was in place at the time of the attack, and the duodenal juice withdrawn at this time was dark mahogany brown, containing much bile pigment. The blood serum withdrawn at the height of the attack was cherry red in appearance (hæmoglobinæmia) and the fragility of the red cells showed hæmolysis beginning at 0.50 per cent and complete at 0.42 per cent sodium-chloride solution. The urine was heavily pigmented, giving positive tests for urobilinogen and urobilin and negative tests for bile pigments. There was no hæmoglobinurea. The stools were somewhat lighter in color than usual but could not be considered acholic. After 24 hours the jaundice began to fade.

Three days later an adrenalin test was made after the method of Frey and Lury and Abl. Ten minims of 1:1,000 adrenalin solution was injected deep into the muscles, this producing a prompt reduction in the size of the spleen. In 40 minutes it shrunk from 27 to 21 cm. in length and receded from 5.5 to 7.5 cm. from the median line of the abdomen. It became visibly smaller, but 12 hours later had returned to the usual size. The fragility of the red cells was not affected by the experiment.

Operation: Wesley Hospital, April 7, 1915. Operator, Dr. Kanavel; assistants, Drs. Hills and Stranberg. Anæsthetic, gas and ether.

The incision was made along the left border of the left rectus, extending from the umbilicus to the rib margin. Many adhesions were found about the upper pole, which were stripped off, one large band being ligated. Double clamps were placed upon the pedicle, the tail of the pancreas being excluded. The pedicle was cut and ligated with double ligature. Blood was taken from both artery and vein for fragility test. The artery was then tied separately. The liver was of bluish color, did not look or feel cirrhotic. The wound was closed in layers.

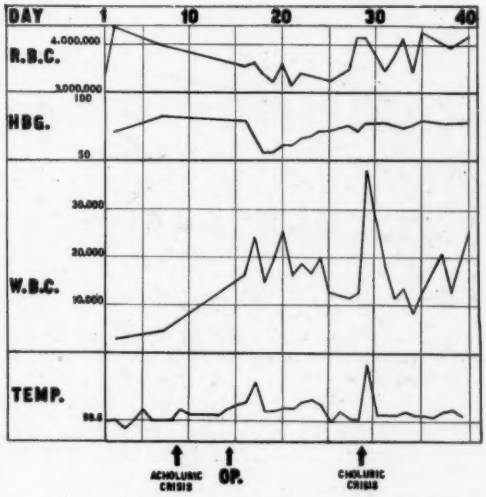

Fig. 2. Clinical chart. At final count, ten weeks after the operation, the red blood-cells were 4,248,000.

The post-operative course was uneventful, except for an unexplained temperature on the second and third days, which subsided completely. There was also a choluric crisis later, as will be seen by a study of the chart.

Immediately following the operation the patient complained of pain at the tip of the left shoulder, which continued, gradually decreasing while he remained in the hospital, and which we ascribed to the disturbance incident to the breaking up of adhesions between the diaphragm and spleen, there being no evident disturbance in the chest.

There was a prompt increase in the leucocytes and a decrease in the red cells following the splenectomy, as was to be expected from the reports from Pierce's laboratory. The leucocytes continued high, averaging 15,000 to 25,000. Later the red cells began to increase in numbers, reaching 4,192,000 upon discharge from the hospital, upon the fortieth day, a higher count than at any other time while he was under observation.

There was a rise in temperature upon the second day following the operation, reaching 102°, which promptly returned to normal in 24 hours, a phenomenon following splenectomy that has been previously observed and commented upon (Mühsam).

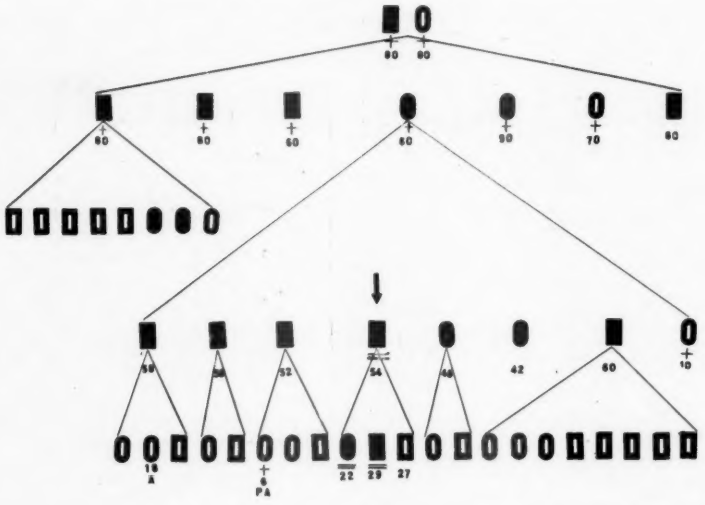

Fig. 3. Genealogical tree of the "B" family. The dead black areas represent jaundiced members. The arrow points to the member operated upon. The member noted as +6PA died at the age of six under the diagnosis of pernicious anæmia. That marked 18A is described as being anæmic. The figures set under the signa denote the age of the individual at which he died. The plus sign represents death. The parallel lines indicate that the patient has been examined.

Upon the fifteenth day following the operation the patient complained of much pain in the liver region (choluric crisis), had two severe chills in rapid succession, developed a temperature reaching 103.8°, a white count of 39,800, and became markedly more jaundiced. The urine was scanty, was very dark colored, and gave intense reactions for bile pigments.

This crisis (choluric) differed from the previously observed crisis (acholuric), in that all of the above-mentioned phenomena, except the jaundice, were absent in the first instance, and we concluded that this crisis was obstructive in origin, due to a disturbance in the gall-ducts — either adhesions or pigment stones still present. The attack disappeared in 24 hours, after which the patient continued to gain in strength and general health until he left the hospital.

The jaundice became markedly less soon after the operation, was almost entirely gone at the end of a week, and, aside from the exacerbation at the time of the choluric crisis, continued to disappear, so that upon dismissal the presence of icterus was noted only upon examination of the scleræ. As he put it, he had a clear skin for the first time in 21 years.

Physical examination. June 3, 1915 (64 days post-operative). There has been a progressive improvement in the general condition of the patient since leaving the hospital, with only one day of illness ("indigestion"), evidently not associated with the disease process. There have been no crises of any kind during this period. The blood shows 4,248,000 red cells, 10,350 white cells, and 83 per cent hæmoglobin. The fragility test shows hæmolysis begins at 0.50 per cent and complete at 0.32 per cent. The urine is normal and gives negative tests for bile pigments and urobilin. There is possibly a trace of jaundice present, as it is difficult to judge in his case, as he still looks anæmic. Physically there is a generalized small gland adenopathy present; otherwise the condition is the same as when last seen. He states that he feels well and is gaining in strength daily.

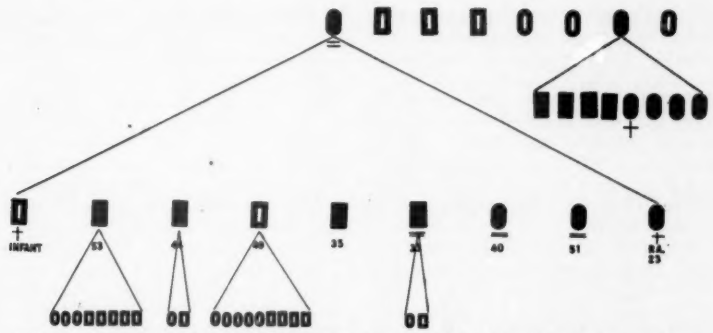

Fig. 4. Genealogical tree of the "H" family. See Fig. 3 for description of signa.

Professor Simonds reported on the microscopic picture, as follows:

The capsule and trabeculæ are thickened. The smaller arteries show marked hyaline degeneration. The arteries and veins contain very little blood. The malpighian bodies are few in number and atrophic. None show typical germ centers. In some there are round or oval areas corresponding in size and location to the usual germ centers. These areas contain a few lymphocytes, but the majority of the cells composing them are either elongated cells with spindle-shaped, palely staining nuclei (probably fibroblasts) or large, round, oval, or polygonal cells with oval or indented palely staining nuclei (probably endothelial cells). Mitoses are seen in both types of cells.

The splenic pulp is markedly atrophic. The capillaries and sinuses are filled with blood. The blood-cells and the endothelium of the capillaries and sinuses make up almost the entire cell content of the pulp. There is very moderate increase of connective tissue.

Practically no large phagocytic cells containing red blood-corpuscles or blood-pigment are to be seen. Sections treated with potassium ferro-cyanide and hydrochloric acid showed an unusually small amount of iron-containing pigment.

Numerous spaces varying from approximately 20 to 60 μ in diameter and probably corresponding to the pulp views are seen in all sections. Most of them contain very little blood and appear as empty, or almost empty, round, oval, or elongated spaces lined with cells with very prominent nuclei. In a number of these veins there are hyaline thrombi; in others, there is a fine meshwork of fibrin containing a few red blood-corpuscles and leucocytes.

Professor Kendall reports the following bacteriological findings:

Cultures, both aërobic and anaërobic, were made from the spleen of the patient in media, with and without blood and ascitic fluid. A slight growth appeared in dextrose broth after four days' incubation, which proved to be a short bacillus, occurring singly and in pairs. Subcultures were obtained in dextrose broth for four generations, but large amounts of material — five cubic centimeters at least — were required to obtain successful growths in fresh media. After four generations the organism refused to develop, and attempts to inoculate other media were wholly unsuccessful.

Large amounts of culture — five cubic centimeters — were introduced into the ear vein of a rabbit and five cubic centimeters intraperitoneally into another rabbit with absolutely negative results.

No conclusions can be drawn from these experiments other than that the organism does not appear to be a contamination in the ordinary sense. Its relation to the lesion is wholly unknown.

Case 2. (R. B. A., family icterus, 3 crises.) The daughter of A. M. B. (Case 1), who presents herself on account of jaundice. A young married women, 22 years old, has always been well except that she has been more or less jaundiced and anæmic since childhood. As a child she had had many attacks thought to be "biliousness," during which she would become jaundiced, the attacks lasting about two weeks. She has had three severe crises during the past two years. The *first crisis*, January, 1913, was ushered in with intense headache, nausea, vomiting, and an intense jaundice. She was very sick for three weeks, the jaundice remaining for six months. She states that she became very anæmic following this attack. The *second crisis*, November, 1913, started with an intense headache, which lasted five days; the jaundice, at first slight, became intense and persisted for 3 months. Following this attack she became more anæmic, was weak and easily nauseated, and the spleen was found to be much enlarged. Much of her hair fell out. The *third crisis*, December, 1914, less severe but similar to the previous attacks.

Examination, April 8, 1915, shows an anæmic appearing young woman, decidedly jaundiced but

well nourished. The spleen is very large, extending to one inch below the level of the navel. The liver is just palpable, but not tender. Red blood-cells, 3,392,000; white cells, 7,200; hæmoglobin, 85 per cent. The fragility test shows that hæmolysis begins at 0.50 per cent and is complete at 0.38 per cent. The urine is negative, there being negative tests for bile pigments, urobilinogen and urobilin.

Splenectomy was advised but the operation deferred until the result of the operation in her father's case can be definitely known.

CASE 3. P. B., family icterus, slight manifestations. A healthy medical student, age 27 years, has never been seriously ill, but has had a "sallow complexion" all his life. Following a recent tonsillitis he became decidedly jaundiced. There is no history of critical attacks.

Upon examination he appears sallow, but there is no icterus. The spleen is palpable, extending one inch below the ribs on deep inspiration, and is tender. The liver is not palpable. Red cells, 5,184,000; white cells, 9,600; hæmoglobin, 100 per cent. Fragility test shows that hæmolysis begins at 0.50 per cent and is complete at 0.36 per cent sodium-chloride solution. The urine is entirely normal, there being a negative test for bile pigments, urobilin, and urobilinogen.

The "B." family, including the above three cases, is typical of hæmolytic family icterus, as previously described by others. In this family this affliction probably descends from the maternal great-grandfather. There are six of the second, seven of the third, and at least two of the fourth generation (the latter mostly children at the present time) who are supposed to have hæmolytic family icterus. It is significant that of the first and second generations none died under 60 years, and most of them lived to be 80 years of age or over, while of the fourth generation at least one died of "pernicious anæmia" at ten years, one is intensely anæmic at 18 years, and one has intense crises and is in a poor physical condition at 22 years. It is also significant that there are those in a generation who are but little afflicted while the brothers and sisters are seriously afflicted with this disease. Apparently sex has no influence upon the disease in this family.

CASES 4 to 8. (Hæmolytic family cholæmia, Gilbert type). This family "H.," including four observed individuals, a mother and three adult children, present the manifestations of the mild form of this disease. Six of the second generation, that is, all who reached adult life except one, are sallow, have attacks of "biliousness" associated with jaundice of slight grade, are rarely markedly jaundiced, and none of them are markedly anæmic. The spleen is palpable in two, the fragility is increased in three, and there is a history of acholuric crises in two of the family examined. In this family the disease is supposed to come down through the mother, who is herself icteric, has an increased fragility and a palpable spleen, and of whose sisters one has eight icteric descendants.

It is significant that one of the second generation died at 29 with a diagnosis of pernicious anæmia, and that another has had a gall-bladder operation. Of the others of this generation their ages range from 33 to 53, and they enjoy good health.

CASE 9. (C. L. W., acquired hæmolytic icterus.) A student, 24 years of age, complains of extreme lassitude, rather constant headache, constipation, and jaundice of light grade but variable, of ten years' duration. He seeks relief in the belief that the lassitude is of intestinal origin.

Upon examination he is found to be but slightly icteric; the spleen is enlarged, extending 1.5 inches below the costal margin. The blood shows 6,524,000 red cells, 6,524 white cells, and 85 per cent hæmoglobin. The fragility of the red cells is increased, hæmolysis first appearing at 0.54 per cent and is complete at 0.32 per cent sodium-chloride solution. The urine gives negative tests for bile pigment, urobilinogen, and urobilin. The patient is under observation and splenectomy is being considered, since it seems to offer the only relief. This patient is partially incapacitated on account of the illness.

The fragility test of Chauffard and Widal was carried out according to the Eppinger technique, and washed red cells were used for the most part, although this is not considered essential. There was obtained 10 ccm. of blood, which was defibrinated, centrifuged, washed in 0.6 per cent salt solution, again centrifuged, and 0.6 per cent salt solution added to make up to the original volume. Varying concentrations of hypotonic salt solution were arranged in a progressive series in small test tubes, ranging from 0.6 per cent to 0.3 per cent. This was readily accomplished by dropping 0.6 per cent salt solution from a burette, in diminishing amounts, and later dropping distilled water in increasing amounts, from the same burette, to make up to equal volumes. In the first tube 60 drops of salt solution and no water was used, therefore 0.6 per cent; in the second tube 58 drops of salt solution and 2 drops of water, therefore 0.58 per cent; in the third tube 56 drops salt solution and 4 drops water, therefore 0.56 per cent, and so on until 0.3 per cent was reached. To facilitate matters one-half of these quantities were used. To each test tube one drop of the washed red corpuscles was added. The tubes were allowed to stand at room temperature for two hours, at which time the reading could be made, or later if desired.

FRAGILITY TEST, CASE 1, SPLENECTOMY

	Hæmolysis Begins	Complete
March 25, 1915	.50	.38
March 27, 1915	.52	.36
April 1, 1915, Acholuric crisis	.50	.42
April 5, 1915, Adrenalin test, before	.50	.44
Adrenalin test, 40 min-after utes	.50	.44
April 7, 1915, Op. Blood from Splenic vein	.46	.40
Blood from Splenic artery	.50	.44
April 30, 1915, Discharge	.54	.40

FRAGILITY TEST, ALL CASES EXAMINED

	Hæmolysis Begins	Complete
A. M. B. (father), first family	.52	.40
P. R. B. (son), first family	.50	.36
R. B. A. (daughter), first family	.50	.38
C. H. (mother), second family	.50	.32
Ch. H. (son), second family	.52	
R. H. (daughter), second family	.46	.28
C. H. (daughter), second family	.48	.28
C. L. W. (non-familial)	.54	.32

ARTERY-VEIN FRAGILITY IN DOGS

		Hæmolysis Begins	Complete
Dog 1.	Splenic artery	.52	.36
	Splenic vein	.54	.36
Dog 2.	Splenic artery	.48	.32
	Splenic vein	.46	.32
	Femoral artery	.50	.32
	Femoral vein	.50	.32
Dog 3.	Splenic vein	.46	.32
	Femoral artery	.44	.30
	Femoral vein	.44	.30
Dog 4.	Splenic artery	.46	.32
	Splenic vein	.42	.32
	Femoral vein	.44	.32

At the operation of Case 1 blood was obtained from both the splenic artery and splenic vein. The fragility of the arterial blood was found to be higher than that from the vein; i.e., hæmolysis began at 0.5 per cent and 0.46 per cent respectively. Graf had found no difference in a similar experiment. We then tried similar experiments upon dogs, and while a difference was usually detected, yet it was not constant, and no conclusions can be drawn.

That the fragility is not constantly increased in all cases of hæmolytic jaundice has been observed. It was not materially increased in two individuals of the second family here reported; one of these had had well-defined crises, but both were in good health when examined. It is quite likely that the fragility changes from time to time, as has been described, and it may persist a long time after splenectomy. An increased fragility may be present in other conditions, but is unusual. We found a high fragility in a case of nephritis with much anæmia; i.e., hæmolysis beginning at 0.50 per cent and complete at 0.32 per cent.

In obstructive jaundice, pernicious anæmia, and splenic anæmia the resistance of the red cells (lowered fragility) is increased, which is not only an aid to diagnosis but also serves to point out certain cases which appear under the clinical picture of pernicious anæmia and Banti's disease.

PATHOGENESIS

It is generally considered that the hæmoglobin molecule is split in the circulating blood or spleen into two fractions; the first, the iron-containing (hæmatin) fraction, is conserved in the liver (Kupffer cells), bone-marrow, and other parenchymatous organs, and the second, the pigment-containing fraction, is excreted by the liver as bilirubin. The bilirubin being converted into urobilinogen in the intestine is absorbed and excreted as such by the kidneys.

Just what the pathogenesis of this disease may be is not definitely known at the present time. Recent operative results set aside all former theories (hepatogenous) which do not ascribe to the spleen the principal etiological rôle. It is safe to say that if the spleen is not the sole cause it is at least an essential factor in the pathogenesis of this disease. The old theories of liver origin must be discarded, but there seems no question but that the liver plays an important part in the disease process.

Chauffard and Widal consider hæmolytic icterus essentially a blood disease, the splenic tumor spodogenous, and the decreased osmotic resistance (increased fragility) of the red cells the essential factor.

Eppinger considers altered splenic function the essential etiologic factor, speaking of it as

HÆMOLYTIC JAUNDICE. SPLENECTOMIES

Case No.	Author	Age and Sex	Splenomegaly	Symptoms	Family History	Fragility	Blood Picture	Date of Operation	Result	Complications	Remarks
1	Dawson. Proc. Roy. Soc. Med., 1914, vii, v, 84	—, F.	+		Son	Still present although splenectomy in 1887		1887	Cured of jaundice		Operated upon by Sir Spencer Wells.
2	Bland-Sutton. Lancet, Lond., 1895, ii, 974, and Brit. J. Surg., 1913–14, i, No. 2, 157	17, F.	+ Huge size	Jaundice and anæmia.	Probably congenital			1895	10 years later in good health		
3	Vaquez. Semaine méd., 1907, 46, 551	34, F.	+	Icteric since age 15. Splenic colic, very severe.		0.64 per cent	R.B.C. 2,900,000	1907	Died following operation		Spleen 850 gm. Autopsy.
4	Banti. Semaine méd., 1912, No. 23, 265	41, F.	14 years	14 years, anæmia; pain in splenic region. Jaundice. Urobilinuria.	Acquired	0.6 per cent, became normal a few days after operation	Before: R.B.C., 2,190,000; Hb., 50 per cent; W.B.C., 7,029. 7 days after: R.B.C., 2,565,000; Hb., 35 per cent. Nov. 3, 1911: R.B.C., 4,075,000; Hb., 70 per cent; W.B.C., 7,735.	II 20 1903	Cured		Spleen 1,580 gm. 8 years later in good health.
5	Banti. Semaine méd., 1913, No. 27, 313	41, F.	2 years	2 years, anæmia. 1 year ago, pregnancy, followed by progressive anæmia, palpitation, œdema. 8 days before operation, jaundice with slight enlargement of liver. Urobilinuria and intermittent bile in urine.	Acquired	Normal	2 days before: R.B.C., 2,190,000; Hb., 20 per cent; W.B.C., 3,000. 10 days after: R.B.C., 5,850,000; Hb., 65 per cent; W.B.C., 8,260. 6 months after: R.B.C., 3,737,000; Hb., 43 per cent; W.B.C., 11,266.	V 18 1912	Cured		Spleen 970 gm. Wassermann 0.
6	Umber. Ztschr. f. klin. Med., 1904, lv, 289	15, M.	8 years	Anæmia. Intermittent jaundice for 1 year. Urobilinuria. Liver 9 cm. down. Epistaxis.	None Congenital		Before: R.B.C., 3,900,000; Hb., 50 per cent; W.B.C., 8,500. After 3 months: R.B.C., 5,000,000; Hb., 100 per cent; W.B.C., 12,000.	II 27 1904	Cured		Spleen 1,300 gm. Probably a congenital hemolytic jaundice. Reported as Banti's disease.
7	Burghard and Sutherland. Proc. Roy. Soc. Med., 1911, iv, Clin. Sect., 58; Lancet, Lond., 1910, ii, 1819	12, F.	8 inches in long diameter	2 years, anæmia, joint-pains and swelling. Pale yellow tint. No bile in urine.	Sister died of "splenic anæmia," aet. 13		Before: R.B.C., 2,420,000; Hb., 56 per cent; W.B.C., 9,800. After: R.B.C., 4,740,000; Hb., 98 per cent; W.B.C., 7,000.	VII 20 1906	Icterus gone in 10 days. Cured		Spleen 907 gm. Reported as splenic anæmia. Doubtful case.
8	Burghard and Sutherland. Same	6, F.	1 finger-breadth below navel	Epistaxis once. Anæmia and fever.	Father Uncle		Before: R.B.C., 2,550,000; Hb., 34 per cent; W.B.C., 6,300. After 7 weeks: R.B.C., 5,300,000; Hb., 86 per cent; W.B.C., 13,600.	X 17 1910	Jaundice gone 4 days after operation. Cured		Spleen 453 gm. Wassermann 0. von Pirquet 0. Reported as splenic anæmia. Doubtful case.
9	Roth. Ztschr. f. klin. Med., 1912, lxxvi, 23	25, M.	Soon after brith	Jaundice soon after birth of variable intensity. Frequent pain in splenic region. Attacks of fever and icterus. Splenectomy in 1908 in German Hospital, N. Y., after severe attack. Diagnosed "splenic anæmia."	Grandfather Father	0.6 per cent 3½ years after operation	3½ years after operation: R.B.C., always over 5,500,000, highest 6,468,000; Hb. always 100 per cent, highest 114 per cent. "Jolly-bodies" in red cells.	1908	Cured	Epilepsy soon after operation	Fragility present, and traces of urobilin in urine 3½ years after operation. It is doubtful whether they ever disappeared.

10	Micheli. Wien. klin. Wchnschr., 1911, xxxvi, 1269; also Semaine méd., 1912, 65 and 265	22, M.	3 years Spleen to level of navel	3 years, anæmia and splenic tumor. Slight jaundice. No bile in urine. Occasional brief fever.	Acquired	Marked increase, 0.6 per cent. 2 weeks after, 0.48 per cent	Before: R.B.C., 2,000,000; Hb., 30 per cent. 2 weeks after: R.B.C., 4,020,000; Hb., 65 per cent; W.B.C., 6,375. 7 weeks after: R.B.C., 4,700,000; Hb., 80 per cent; W.B.C., 7,200.	V 23 1911	Jaundice disappeared in 2 weeks. Liver smaller. Cured		Spleen 885 gm. Splenunculus left.
11	Antonelli. Semaine méd., 1912, xlvi, 547		Enlarged	Clinical picture developed in a few months.	Acquired	Increased	Blood picture of pernicious anæmia. R.B.C., 709,000 to 2,000,000. After: R.B.C., 4,000,000.	VII 16 1912	Clinical improvement		
12	Kahn. Verhandl. d. deutsch Cong. f. innere. Med., 1913, 326	28, F.	Noticed in 1906	For 8 years pain over spleen and liver. Urobilinuria. Bilirubin in blood serum, not in urine. Jaundiced for 4 years.	Father and 6 (of 10) of his children	Increased	Before: R.B.C., 2,920,000; Hb., 50 per cent. After: R.B.C., 4,900,000; Hb., 90 per cent.	1912	Jaundice increased immediately after operation, but with urobilinuria disappeared in 12 days		Spleen 1,170 gm.
13	Kahn. Same	19, M.		6 years, jaundice of varying intensity. Bilirubin in blood serum. Urobilinuria.	Mother Maternal grandmother 2 uncles 1 aunt	Increased. Improved, but still increased after operation	Before: R.B.C., 4,500,000. After: R.B.C., 5,700,000. Later: 4,500,000.	1912	Jaundice at first increased, then disappeared		Spleen 970 gm.
14	Ranzi. Wien. med. Wchnschr., 1913, lxiii, 26, 1627; also Mitt. a. d. Grenzgeb. d. Med. u. Chir., 1914, iv, 796	30, F.	Marked	Jaundiced for 4 years.	Acquired		Before: R.B.C., 1,700,000; Hb., 35 per cent. Blood picture of pernicious anæmia. After ¾ year: R.B.C., 5,000,000; Hb., 100 per cent.	IV 12 1913	After ¾ year, condition good. Gained 12 kg. No jaundice		Spleen, 1,300 gm. Extensive adhesions. Operation by Ranzi.
15	Eppinger and Ranzi. Mitt. a. d. Grenzgeb. d. Med. u. Chir., 1914, iv, 796.	21, F.	Marked	Icterus for 2 years.	Acquired		Before: R.B.C., 3,000,000; Hb., 38 per cent. After 1½ years: normal.	IV 6 1912	After 1½ years, no jaundice. Gained 10 kg.		Spleen 1,050 gm. Moderate adhesions. Operation by Clairmont.
16	Eppinger and Ranzi. Same	27, F.	Marked	Icterus for 7 years.	Acquired		Before: R.B.C., 2,000,000; Hb., 47 per cent.	IX 7 1913	After 2 months no jaundice. Able to work. Gained 3½ kg.		Few adhesions. Operation by Ranzi.
17	Ranzi. Wien. med. Wchnschr., 1913, lxiii, 1627	54, F.	Marked, to within 2 finger-breadths of midline	Attacks of pain in right, later also in left upper abdomen for 1 year. Severe jaundice. Pruritus. Liver enlarged.	Acquired			IV 15 1913	After 1 month feels well, jaundice all gone		Spleen 1,400 gm. Upper pole adherent.
18	Ranzi. Same	46, M.	Hand's breadth down	Stomach trouble for 7 years. Pain in splenic region for 1 year. Icterus of varying intensity.				IV 11 1913	Improvement. Gained 4 kg.		Spleen 750 gm.
19	Ranzi. Same	45, M.	Since 1902. As far down as navel	Spleen and icterus since 1902. Worse in last year. Liver enlarged. Bleeding of gums.	Acquired			IV 21 1913	Condition good 3 weeks after operation		Spleen 1,000 gm.

HÆMOLYTIC JAUNDICE. SPLENECTOMIES—*Continued*

Case No.	Author	Age and Sex	Splenomegaly	Symptoms	Family History	Fragility	Blood Picture	Date of Operation	Result	Complications	Remarks
20	Ranzi. Same	53, F.			Acquired			V 14 1913	Operation 1 day before reported		Resembled preceding case.
21	Thursfield. Proc. Roy. Soc. Med., 1914, vii, Clin. Sect., 84, and St. Bartholomew's Hosp. Reports, 1913, xlix, 51	9, M.	To within 1 inch of iliac crest	Jaundice since birth. Pale, lemon yellow tint, deepening at intervals. Anæmia and shortness of breath. Urobilinuria.	Nil Congenital	0.6 per cent. Remained unchanged after operation; 9 months after, still to 0.5 per cent; 15 months after, normal	9 months before: R.B.C., 1,460,000; Hb., 30 per cent; W.B.C., 14,000. Day before: R.B.C., 1,400,000; Hb., 70 per cent; W.B.C., 4,000. 9 month after: R.B.C., 5,186,000; Hb. 95 per cent; W.B.C., 16,460. 15 months after: R.B.C., 5,000,000; Hb., 100 per cent; W.B.C., 11,500.	X 21 1912	Jaundice disappeared in 17 days. Urobilinuria disappeared immediately. Cured	Post-operative leukocytosis to 36,000	Spleen 597 gm. 3 spleneculi seen and left. Wassermann 0. No bile in cerebro-spinal fluid or blood serum.
22	Wynter. Proc. Roy. Soc. Med., 1913, vi, Clin. Sect., 33, and Clin. Sect., 1914, p. 82	22, F.	Much enlarged	Jaundiced from birth, intensity varying. Urobilinuria. No bile in urine. Liver not enlarged.	Nil Congenital	0.55 per cent, improved at once	Before: R.B.C., 2,710,000; Hb., 52 per cent; W.B.C., 13,000. 1 month after: R.B.C., 3,365,000; Hb., 84 per cent; W.B.C., 7,000. 15 months after: R.B.C., 5,000,000; Hb., 110 per cent.	XII 11 1912	Immediate relief. Jaundice gone in 12 hours. Cured		Spleen 1,360 gm. Wassermann 0.
23	Box. Proc. Roy. Soc. Med., 1913, vi, Sect. Dis. Child., 8	12, F.	Since infancy	Jaundiced for 6 weeks after birth. 4 and 5 years ago, purpura with hæmatemesis. For 4 years recurrent attacks of vomiting with splenic pain and swelling and jaundice.	Mother Brother Sister	After operation 0.5 per cent	Before: R.B.C., 3,337,000; Hb., 65 per cent; W.B.C., 10,640.	Sept. 1912	Death 6 weeks after operation	Sepsis of pedicle. Joint pains, vomiting of bile. Later uræmia.	Spleen 390 gm. No free iron. Autopsy. Free iron in liver.
24	Gilbert. Presse méd., 1914, xxii, 21	45, M.	To iliac crest and almost to pubes	Jaundice and pallor. No bile in urine. Urobilinuria. Bilirubin in serum.	Mother Sister Probably congenital	Increased 0.5 per cent. Unaltered 10 weeks after operation	2 months before: R.B.C., 1,400,000; Hb., 45 per cent; W.B.C., 2,500. After 10 weeks: R.B.C., 2,500,000.	XII 12 1912	Icterus gone in 3 weeks		Spleen 950 gm.
25	Laukhaut. Quoted from Folio Hæmatol., 1914, xv, 286	42, F.	17 years To symphysis pubis	Intermittent jaundice and fever. Urobilinuria. No bile in urine. Liver much enlarged. No ascites.			Before: R.B.C., 3,750,000; Hb., 65 per cent; W.B.C., 1,660. 1 week after operation: R.B.C., 4,000,000; Hb., 52 per cent; W.B.C., 5,900. 4 months after: R.B.C., 4,800,000; Hb., 73 per cent; W.B.C., 8,400.	XI 9 1912	Cured		Spleen 4,500 gm.
26	Fiori. Sperimentale, 1913, lxvii, 189	19, M.	To midline, tender Variable size	Pale at 9 years, jaundiced at 12. At 15, an attack of fever. Spleen and liver enlarged. At 18, weak, short of breath. Nose-bleeds. Urobilin and at times traces of bilirubin in urine.	Sister Congenital	0.62. per cent After 18 days, 0.48. per cent Same 3 months later	Before: R.B.C., 2,300,000; Hb., 57 per cent; W.B.C., 6,200. After 3 days: R.B.C., 3,600,000; Hb., 70 per cent; W.B.C., 9,100. After 7 months: R.B.C., 4,850,000; Hb., 94 per cent; W.B.C., 5,700.	VII 2 1912	Epistaxis stopped. Jaundice gradually faded. Urobilinuria absent on 11th day. Left hospital in good condition on 17th day		Spleen 1,000 gm. Wassermann 0.

27	Graf. Deutsche Ztschr. f. Chir., 1914, cxxx, 462	22, F.	6 years ago To navel	6 years ago, vomited and had pain in splenic region. Jaundice of varying intensity. "Gall-stone" colics. Liver barely palpable. Urobilinuria. No bile in urine. Leg ulcers.	Father and 6 (of 10) of his children	Increased. After 4 months not yet normal	Before: R.B.C., 2,920,000; Hb., 50 per cent; W.B.C., 9,250. After 1 month: R.B.C., 3,980,000; Hb., 80 per cent; W.B.C., 6,500. After 1 year: R.B.C., 5,080,000; Hb., 75 per cent; W.B.C., 10,600.	II 17 1913	Icterus increased for several days. After 16 days, entirely gone. No urobilin in urine. Cured	Gall-stone colic. Cholecystectomy on 8.2.13. Recov.	Spleen 1,175 gm. Adhesions. Stones in gall-bladder.
28	Graf. Same	12, F.	Upon standing, 11 cm. below navel	Appearance of pregnant abdomen—veins dilated. Liver 2 fingers down. Icteric. Adenopathy. Leg ulcers.	Sister of above	Increased. After 10 months not quite normal	Before: R.B.C., 2,400,000; Hb., 35 per cent; W.B.C., 12,500. After 3 months: R.B.C., 5,900,000; Hb., 60 per cent; W.B.C., 7,500. After 10 months: R.B.C., 6,900,000; Hb., 80 per cent; W.B.C., 16,400.	V 17 1913	Jaundice gone in a few days. After 10 months, strong. No urobilinuria. Liver 2 fingers down	Purulent bronchitis	Spleen 1,025 gm. Wassermann 0.
29	Graf. Same	38, M.	4 fingers down	Jaundiced occasionally for 9 years. Exacerbations every 6–7 weeks. Liver 2 fingers down. Hæmorrhoids.	Acquired	Almost normal 9 months after operation	Before: R.B.C., 4,000,000; Hb., 50 per cent; W.B.C., 7,800. 9 months after: R.B.C., 4,200,000; Hb., 70 per cent; W.B.C., 11,700.	VI 8 1913	9 months after operation no urobilinuria. Able to work. Cured		Spleen 750 gm. Adhesions. Wassermann 0.
30	Pollitzer. Wien. klin. Wchnschr., 1913, p. 952; also 1913, p. 1497	13, F.	Since age of 2	Temporary jaundice at 5 months. Again at 5 years, and continuously thereafter. Attack. Good health until 2 years ago when recurrent abdominal pains appeared.	No Congenital	Increased 0.54 per cent	Slight chlorotic changes.	V 10 1913	Icterus gone in 3 days. Liver colics worse		Spleen 650 gm. Much perisplenitis. Wassermann + at 11 years. With salvarsan injection icterus disappeared for a time.
31	Boyd. Proc. Roy. Soc. Med., 1914, vii, Clin. Sect., 56	22, M.	2 fingers below costal margin	4 years lassitude, occasional vomiting, giddiness, varying intensity of icterus. 18 months ago gall-bladder was explored with negative result.	Acquired	Very slightly increased	2 weeks before: R.B.C., 4,200,000; Hb., 80 per cent; W.B.C., 5,900. Poikilocytosis. Polychromatophilia.	IX 8 1913	Jaundice disappeared in 1 week. Cured		Wassermann + before operation, perhaps due to bile. Negative after operation.
32	Dawson. Proc. Roy. Soc. Med., 1914, vii, Clin. Sect., 101	22, F.	Detected October, 1913 To navel	6 years icterus in recurrent attacks. Bile in urine only during febrile attack. Urobilinuria.	Acquired	0.6 per cent. Unchanged 2 weeks after operation	2 months before: R.B.C., 4,000,000; Hb., 45 per cent; W.B.C., 10,000. Normoblasts. Poikilocytosis. Anisocytosis.	Dec? 1913	After 2 weeks, jaundice all gone. No excess urobilin in urine. No bile in blood serum. Cured	Cholecystectomy 4 weeks before splenectomy 4 stones	Wassermann 0.
33	Mosse. Verhandl. d. Berl. med. Gesellsch., Berl. klin. Wchnschr., 1913, xlv, 2088	38, F.		Anæmia. Urobilinuria.	Acquired	0.68 per cent. Normal 5 weeks after operation	2 weeks before: R.B.C., 1,150,000; Hb., 30 per cent; W.B.C., 3,000. After 11 weeks: R.B.C., 4,150,000; Hb., 70 per cent; W.B.C., 8,500.	VI 25 1913	Cured	Leukocytosis and many normoblasts immediately after operation	Spleen 570 gm. Left femoral vein thrombosis 5 weeks after operation. Recovered after 4 months. Published as "pernicious hæmolytic anæmia."
34	Decastello. Wien. med. Wchnschr., 1913, xxiv, 1496	52, F.	Marked	Well until 1 year ago, except for occasional splenic pain. 7 months ago, acute tonsillitis followed by jaundice. Liver enlarged. Achulia gastrica.	Acquired	Much increased	Before: Picture of pernicious anæmia. Reds as low as 750,000. After: Rapid increase in reds nearly normal.	III 1913	Icterus increased for a few days. Gone within 10 days. Feels well	Bronchitis. Decubitus	Reported as pernicious anæmia. Probably a hæmolytic jaundice.

HÆMOLYTIC JAUNDICE. SPLENECTOMIES—*Continued*

Case No.	Author	Age and Sex	Splenomegaly	Symptoms	Family History	Fragility	Blood Picture	Date of Operation	Result	Complications	Remarks
35	Pendl. Berl. klin. Wchnschr., 1914, li, 178	35, F.	To midline, almost as far as navel	Icteric for 4 years, liver colic 2 years ago. Spleen not then large. Operation. No stone found. Jaundiced since with little variation. Liver enlarged. Bile and urobilin in urine. Much urobilin in stools.	Acquired		Before: R.B.C., 3,000,000; Hb., 41 per cent; W.B.C., 4,000. After 3 weeks: R.B.C., 4,000,000; Hb., 56 per cent; W.B.C., 12,000.	X 6 1913	Stool normal in 3 days. Urine gradually became normal. After 3 weeks still a little jaundiced. Feels well		Spleen 1,350 gm. Wassermann o.
36	Nobel. Berl. klin. Wchnschr., 1914, li, 1150, 1343	—, M.	+	Observed 1 month before. Jaundice. Urobilinuria.	Congenital	Increased	1 month before: R.B.C., 1,400,000; Hb., 40 per cent; W.B.C., 206,000. Just before: R.B.C., 800,000; half nucleated Hb., 15 per cent; W.B.C., 100,000. After: R.B.C., 3,600,000; Hb., 47 per cent; W.B.C., 10,000.	1914	Rapid recovery after operation. Jaundice gone		
37	Nobel. Same	8, M.	3 fingers down	Jaundice soon after birth. Yellow since then. Urobilinuria. Attacks of 1–2 days' duration with temperature and headache. Liver 1 finger down.	Congenital	Increased	Before: R.B.C., 2,600,000; Hb., 46 per cent. After 10 days: R.B.C. increased, Hb., 71 per cent.	VI 15 1914	Jaundice less after 24 hours. Gone after 10 days		
38	Whipham. Lancet, Lond., 1914, Nov. 21, p. 1194	6, F.	To navel	Born jaundiced, lasted 3 weeks. Sudden return 21 months ago. Anæmia, epistaxis. Deep jaundice. Liver slightly enlarged.	Congenital	0.55 per cent. Normal 3 months after operation	Before: R.B.C., 904,000; Hb., 25 per cent; W.B.C., 13,180. After 17 days: R.B.C., 4,224,000. After 3 months: R.B.C., 6,000,000; Hb., 70 per cent; W.B.C., 23,000.	IV 7 1914	Rapid improvement. 3 months later no urobilin in urine	After 3½ months jaundice returned. Bile in urine. Death in 3 days. No autopsy	Wassermann o.
39	Harmens. Lancet, Lond., 1915, Apr. 10., p. 749	27, F.	½ inch below level of navel	At 16, swelling in left side. 18 months ago, jaundice. Attack 1 year ago. Liver slightly enlarged.	Mother	0.7 per cent. 2 months after operation, 0.52 per cent	Before: R.B.C., 4,000,000; Hb., 90 per cent; W.B.C., 10,240. 9 days after: R.B.C., 3,612,500; Hb., 75 per cent; W.B.C., 7,800.	VII 27 1914	Condition good 2 months after operation		Wassermann o.
40	Römer. München med. Wchnschr., 1914, No. 9, 501; also Wien. med. Wchnschr., 1914, No. 19, 1029	11,			Probably congenital		Entirely normal after operation.	1914	Jaundice disappeared. Blood normal. Cured		
41	Upcott. Brit. J. Surg., 1915, April, 673	36, F.	1 inch below costal margin	Jaundice from childhood. Gall-stone operation 12 years ago, followed by open fistula for 10 months. Jaundice of varying degree since. Fever at times. Operation 1 year ago for stone in common duct. None found. Gall-bladder anastomosed to duodenum. Jaundice returned after 3 weeks.	Father Sister	0.5 per cent. Same 3 months after operation	8 days after operation: R.B.C., 4,475,000; W.B.C., 11,100. 3 months after: moderate anæmia.	VII 6 1914	Jaundice gone on 6th day. No excess of urobilin in fæces	Hæmatemesis 2 months after operation	Spleen 3 times normal size. Wassermann o. Streptothrix type of organism found in spleen by Gibson.

42 and 43	Exner. Wien. med. Wchnschr., 1913, No. 26, 1627	reports 2 splenectomies with good result. In one case the icterus of several years' standing disappeared in 6 days. In one case after 1 year the blood picture was nearly normal.
44 and 45	Anschütz. Deutsche Gesellsch. f. Chir., 1914, i, 225	reports 2 splenectomies. In one case after almost a year the fragility was still increased. The second case, a girl of 13, had epileptiform attacks 2 days after operation, but these did not continue.
46	Jenkel. Deutsche Gesellsch. f. Chir., 1914, i, 225	reports one operation with recovery.
47	v. Haberer.	is quoted by Mühsam (Deutsche med. Wchnschr., 1914, No. 8, 377) as having reported splenectomy for hæmolytic jaundice.
48	Author's case, see body of article.	

"hypersplenism," in comparison with diseased processes of other ductless glands.

An increase in the unsaturated fatty acids in the blood (Eppinger, King) may be of etiological importance, and the fact that the bile has much to do with normal fat digestion must be cited in support of this theory, the process possibly being a perversion of some normal function.

Whether the hæmolytic agent resides in the spleen or in the general circulation is not known, but it is fair to assume that abnormal hæmolysis is active at all times, and that there are periods of massive hæmolytic activity (acholuric crises). Eppinger estimated the amount of blood destruction as being enormous during the severe crises. He assumed that one molecule of urobilin excreted represents a molecule of destroyed hæmoglobin, and in this way came to the conclusion that during one of the severe crises as much as the total blood supply at any one time may be destroyed, which must be a tremendous drain upon the blood-making organs, which when exhausted produces the blood picture of pernicious anæmia.

DISCUSSION OF RESULTS OF SPLENECTOMY

The first splenectomy for hæmolytic jaundice was reported in 1912 by Banti, the operation having been performed in 1903. Micheli published his case shortly after Banti. Before the picture was recognized earlier operations had been performed in cases which are now known to be hæmolytic jaundice, as, for instance, Sir Spencer Wells in 1887; Bland-Sutton in 1895; Vaquez in 1907. Mühsam, in 1914, stated that to his knowledge the operation had been performed fourteen times with surprisingly favorable results. Thursfield and Gow, in 1914, collected and tabulated 22 cases, of which 12 were congenital (2 doubtful cases) and 10 were acquired forms. In the accompanying table we present 47 cases collected from the literature. These, with our own given in detail, make 48 cases available for study. Of these 16 were of the acquired type, 23 familial, and 9 were unclassified.

The symptomatology and results in these cases in which the diagnosis has been confirmed by operation serve to crystallize our knowledge of the clinical picture and em-

phasize certain points in the pathology and therapy. While the literature of the cases unoperated upon has been consulted, the accompanying remarks are based upon the results shown in the table attached, including only splenectomized cases.

The symptoms in the congenital or familial type differ in no way from those found in the acquired type, except that the latter would seem to progress somewhat more rapidly and more frequently to severe acholuric crises. This is emphasized when we note that in 10 out of 15 cases of acquired jaundice the duration of the jaundice had been short — in fact, less than four years. In regard to the familial type, it was frequently noted that the children in an affected family seemed to suffer more severely than the parent, and they showed a greater tendency to severe crises and the development of complications.

The disease may appear in variable intensity in various members of the family through several generations, and in the great majority of cases is of such a mild character that the patients may live to old age and demand no therapy. In these the condition might pass unnoticed were it not for the icteric tinge to the skin. In certain individuals, however, the process is so marked as to give rise to the typical picture demanding treatment. This may be described as a chronic, mild icterus, with or without indefinite weakness and malaise, upon which are engrafted from time to time the so-called "crises," consisting of marked increase in size and tenderness of the spleen, with malaise, headache, and slight fever, accompanied by an intense hæmolysis, sometimes with hæmoglobinæmia at the height of a crisis, as in our case, with anæmia, urobulinuria, bile pigment in the blood but not in the urine, and a deepening of the acholuric jaundice — this differing from the ordinary jaundice in that it is non-toxic, with no pruritis, no petechia, no bradycardia, and is of a light lemon color; the liver is slightly enlarged and tender and may present the liver crises produced by the passage of the thickened bile or pigment stones through the ducts, giving the typical signs of gall-stone disease. Unless this complication occurs the stools are of normal color.

In our case a duodenal tube was in place during a crisis and the bile content was increased, the duodenal juice being a dark mahogany brown. An examination of the blood will show an increased fragility.

The amount of anæmia depends upon the efficiency of the hæmopoietic system, which, when exhausted, gives the blood picture of pernicious anæmia. One can always find evidence of excessive regeneration, i.e., polychromatophilia, nucleated reds, and certain reticulated bodies in the red cells stained by vital stains, as first described by Vaughan.

During the so-called crises the spleen increases in size and becomes somewhat tender. The spleens removed at operations averaged over 1,000 gms. in weight, one exceptional spleen being reported as 4,500 gms. In 7 only of the 28 cases in which this finding was noted was the spleen under 950 gms. At operation evidences of perisplenitis were present, with adhesions in 8 cases. The age of onset, as noted in 13 of the acquired cases, was most often in the neighborhood of the third decennium. None was seen under sixteen and 3 occurred later in life, at thirty-nine, fifty-one, and fifty-two, respectively. In all of these cases, however, owing to the lack of evident symptoms the disease may have been present previously. While most of the familial cases are noted as having had jaundice in infancy, some did not show this until later, or they were described as being "anæmic."

The anæmia in cases coming to operation varied widely, a few having as low as a million red blood-cells, and some slightly less than normal, but the majority showed from two and one-half to four millions, with a color index of one in nearly every case. The white cells were normal in number, except in 2 cases, where they were below normal, and one extraordinary case, where they reached two hundred thousand. In this patient they reached ten thousand four weeks after operation. Sporadic leucocytosis was seen in many cases at the time of liver crises. In our patient it ran as high as thirty-eight thousand.

In practically every case where the urine was examined, urobilin or urobilinogen was

found, and there were no bile salts except in those cases where the patient was suffering from gall-bladder complications. Bile salts were noted in the blood in some instances. The pains in the abdomen were referred to the splenic region and in a few cases to the liver also. Slight enlargement of the liver was noted in 9 and great enlargement in 2 cases, although such enlargement cannot be said to be a conspicuous sign. There is also no distinct tendency to hæmorrhages of any type, although epistaxis was noted in 4 patients, bleeding of the gums in one, and hæmatemesis in another. The frequency of acholuric crises varied greatly, in the more severe cases appearing every three to four weeks and in the milder cases infrequently.

The most frequent complication met with was the so-called liver crisis, due to the passage of thickened and excessive bile or of gall-stones. In 4 cases gall-stones were removed, one of these being in the common duct. In 2 cases an exploration of the gall-bladder was performed with negative findings.

PATHOLOGY

The findings in the spleens removed showed very little, if any, proliferation of connective tissue. There was frequently a high-grade loss in the follicles and no germinal centers, while the spleen sinuses were dilated at times, constant infiltration of the pulp was more typical, the endothelium was proliferated and filled with coarsely granular hæmosiderin, which was also found in the reticulum about the blood-vessels. The red cells were less sharply outlined and stained less clearly than normal.

The autopsies show little change in the liver, except for the deposit of pigment, partly with iron and partly iron free. This also is seen in the kidneys and bone marrow. The latter also shows the picture of great overaction.

TREATMENT

In many cases the course is so mild as not to call for treatment, and in the more severe cases many years may elapse before the severe crises or complications bring the patient to the physician. The use of iron, arsenic, and other drugs has not served to alter or ameliorate the condition, and X-ray therapy has been tried without result. On the other hand, the remarkable benefit secured by splenectomy, as shown by the accompanying collection of cases, would seem to recommend this procedure, not alone in these severe cases, but also in the milder but progressive types, to forestall the onset of complications on the part of the gall-bladder and relieve those patients who are constantly more or less ill but who do not, as yet, suffer from severe crises. This would seem to be indicated particularly in the younger individuals, where we should not wait for the large splenic tumor or marked general disability which would prevent the proper development of the child. On the other hand, we would not be considered as advising the procedure in the absence of some disability, since a larger proportion of these cases apparently grow to old age without any subjective evidence of illness. Where feasible it is advisable to operate in the free interval between the crises. In our case we administered 10 ms. of adrenalin, 1:1,000, hypodermatically a half-hour before operating, to reduce the size of the spleen. This produced a contraction of at least two inches in the diameter and restored to the circulation that bulk of blood. This certainly was of some benefit, if we assume that it did not at the same time force out toxines from the spleen — and in our case we were able to say that if this occurred it did not produce a marked increase in the hæmolysis.

TECHNIQUE

This is not the place to discuss the technique of splenectomy in general. We may say, however, that the left rectus incision prolonged well up into the costosternal notch gives good access to the field of operation. The dislocation of the spleen is materially aided if the back is raised and bent upward by the kidney elevator or sand bags. The adhesions which are frequently present should be separated gently. In the case here described, the adhesions were very firm, and it was found that if the capsule of the spleen was detached gently with a sponge, so as not to tear the spleen pulp, the resulting oozing

from the denuded spleen could be controlled easily by a laparotomy pad and the detached adhesion caught by long, curved forceps. In case the bleeding is severe, packing may be resorted to and the operation completed at a subsequent period. After the spleen has been dislocated from the abdominal cavity, which should be the first procedure, the pedicle should be clamped with double forceps, the proximal being hæmostatic with rubber-covered blades and the distal crushing, and the spleen cut away as far distal to the crushing forceps as possible. Heavy ligature material should be used and the pedicle ligated either in sections or by a figure-of-eight, so that there is no possibility of slipping. In case of doubt, the artery can be isolated easily and ligated separately. Before the final tying of the pedicle the hæmostatic forceps should be slowly loosened so as to secure the stump more firmly. Care should be taken to separate the tail of the pancreas from the pedicle, although in some cases it may be used intentionally to make a more secure ligation of the stump. It has been suggested that the post-operative rise in temperature frequently noted in splenectomy may be due to the inadvertent inclusion of the tail of the pancreas in the pedicle, but in the case here reported care was taken to isolate the pancreas, and this unexplained transient temperature occurred on the second and third days.

Care should be taken always to examine the gall-bladder during the operation because of the frequency of complicating gall-stones.

The left-sided shoulder pain noted after operation is due to diaphragmatic trauma. This has been particularly brought out by Capps in his study of reflex pain from various types of pleurisy.

PROGNOSIS

Of the 48 cases here collected only 2 died, one shortly after operation, and the other in six weeks, from sepsis, a surprisingly good result when one considers the serious condition of some of the patients. As for the ultimate results, the 46 patients who recovered are reported as "cured"; that is to say, they were relieved of their jaundice and crises. It is true that in most cases the short time that has elapsed between the operation and the report precluded final statement, yet among the reports are those of Dawson, reporting on the case of Sir Spencer Wells, operated upon twenty-seven years previously; Bland-Sutton's case, after ten years; Banti's, after eleven years; Roth's, after six years, while in 9 cases the patients had been observed over six months after the operation.

The effect upon the blood picture was immediate. In some cases reports are made at various stages, and in other cases only once, which will explain any apparent discrepancy in the following figures: In 7 cases reported in the first two weeks 4 gained from one to two million reds; in 8 cases reported in the third and fourth weeks 3 gained over a million, 2 over two million, and 1 over three million; in 9 cases reported in from three to six months 5 gained a million, 4 three million, and 1 five million; and, finally, of 10 reported after six months 1 gained one million, 5 two million, and 4 three million, leaving one that had not gained appreciably, but the blood count here showed four and a half million. These increases in every case brought the blood approximately to normal; in 22 cases it was above four million, and of these, in 17 above four and a half million, and, in 3, six million or over. The hæmoglobin followed the rise in the number of reds. The white blood count was normal unless there were complications.

The effect upon the fragility of the red blood-cells was less conspicuous. The fragility was increased before operation in every case, varying from 0.50 to 0.70. One case is mentioned as becoming normal in five weeks, but for the most part little change was noted before three months, when several are mentioned as being nearly normal. On the other hand, Sir Spencer Wells' case showed a high fragility twenty-seven years after operation, and Roth's after three and one-half years, so it is evident that while one frequently will have a decrease, yet a normal fragility is possibly the exception, rather than the rule, after splenectomy in these cases.

The jaundice decreased in most cases in the

first few days, and in nearly all instances was absent at the end of two weeks, while the acholuric crises, with the attendant *malaise*, headache, and fever, ceased entirely. While too few observations have been made over long enough time to estimate the effect upon the gall-bladder complications, it is not unreasonable, however, to assume that the tendency to these would be decreased or removed.

The authors wish to express their deep obligation to Dr. Walter H. Nadler for his painstaking collection of cases from the literature herewith presented, to Dr. Charles H. Horner for making the fragility tests, to Professor A. I. Kendall for the bacteriological work, and to Professor J. P. Simonds for the histological and chemical studies in the laboratories of the Northwestern University Medical School.

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BLOOD TRANSFUSION BY THE CITRATE METHOD

BY RICHARD LEWISOHN, M.D., NEW YORK

Attending Surgeon, Beth Israel Hospital and Montefiore Home; Associate Attending Surgeon, Mount Sinai Hospital

IN a preliminary communication[1] I reported on a new method of performing blood transfusion with the aid of sodium citrate. This short report dealt mainly with the results of animal experiments. Since that time I have applied the citrate method in twenty-two blood transfusions on eighteen patients. I have thus been able to collect in a comparatively short time (about two months), partly with the kind aid of the staff of Mount Sinai Hospital, a sufficient number of cases to test the clinical value of this new and very simple method of blood transfusion. The object of this paper is to describe these clinical experiences, in the hope that the profession may be induced to give this method a trial on a larger scale and

[1] Med. Rec., 1915, Jan. 23.

form their own opinions as to its clinical value.

HISTORY

The current idea, that transfusion of blood for therapeutic purposes dates back only a few decades, is an erroneous one. In fact, the history of blood transfusion (quoted from Amstel[1]) takes us back as far as 1667, when Denis conceived the idea of blood transfer and used it successfully on the human being. The first one to make use of blood transfusion on a larger scale was Blundell, who reported four cases; two of these ended fatally, but the other two were successful. The largest amount of blood used in these cases was 480 cubic centimeters. It is interesting to note that the use of blood transfusion in puerperal fever dates back as far as 1829, although it has recently been again suggested by different authors. It would go far beyond the scope of this paper to give a detailed review of the extensive work in this field in the nineteenth century, although it is a most interesting study. Transfusion was used over fifty years ago in carbon monoxide-poisoning, eclampsia, leukæmia, etc. Toward the end of the last century it was gradually abandoned in favor of saline infusion. It is only since Carrel's masterful work in blood-vessel surgery that transfusion was taken up again on a large scale, especially in this country. The reason that Carrel's work was such a great step forward is that his method afforded for the first time a safe way of transferring blood from donor to recipient without the risks and dangers of coagulation. The artery-to-vein anastomosis was for a great many years the method of choice in blood transfusions. Its great technical difficulties were obviated to some extent by the use of certain cannulas (Crile, Elsberg, etc.). Later vein-to-vein anastomosis for transfusion was substituted as a more simple and quite as satisfactory a method as artery-to-vein anastomosis.

The greatest objection to the method of direct transfusion, as the anastomosis method is usually called, is not its minute and rather cumbersome technique, but the impossibility of ascertaining the exact amount of the transfused blood. It is obvious that this is a serious objection. That is one of the reasons why in such a short time the syringe method of Lindeman[2] became so popular that it practically did away with all the different direct methods. It might be of historical interest to state here that practically this same method was used by Ziemssen[3] about twenty years ago. It never became popular, however, and was almost forgotten, until Lindeman revived it. There can be no doubt that the syringe method gives excellent results in the hands of experts. It is not a method, however, which can be used by any physician, or for that matter any surgeon, without strict observance of a great many technical details. The syringe method requires for its proper execution three or four people, who must work together with great precision. Furthermore, the method is an expensive one. The usual set consists of twelve twenty-cubic-centimeter record syringes; and if not handled very carefully they break easily, especially during the process of boiling.

The best proof that the method is not an ideal one lies in the fact that since Lindeman's publication several other methods have been devised which modify it. Modifications always tend to show that the original method is not perfect, for nobody will try to improve upon a method which is perfectly satisfactory in everybody's hands. Unger[4] has lately constructed a very ingenious apparatus, which is an improvement on Lindeman's technique. Its essential feature is that the aspiration and injection of the blood is regulated by a double-way stop-cock. In this manner the team-work between the two men working on the donor's arm and the recipient's arm respectively is replaced by a piece of machinery and the prompt working of aspiration and injection of the blood is assured.

Kimpton[5] advised the use of large paraffin-coated glass cylinders (150 to 250 ccm.); after the collection of the blood the cylinder is attached to the recipient's vein and the blood injected with the aid of rubber bulb.

[1] Ploos von Amstel. Bumm's Wien. Klin., 1904.

[2] Lindeman. Med. Rec., 1912, 979; Am. J. Dis. Child., 1913, 28.

[3] Ziemssen. München. med. Wchnschr., 1894, xli, 349.

[4] Unger. J. Am. M. Ass., 1915, lxiv, 582.

[5] Kimpton. Boston M. & S. J., 1913, clxix, 783.

Satterlee and Hooker[1] used weak solutions of hirudin, to rinse out their cannulas and glass cylinders, minimizing the danger of coagulation of the blood during transfer.

The fundamental difference between all methods of transfusion heretofore suggested and the citrate method which shall be described in detail in this paper is based on the following considerations: All the older methods consider the coagulation time of the blood, which normally occurs in about five minutes after the blood has left the vessels, as a *noli me tangere*. They all tried to adapt their methods to this well-known fact. That is the reason why the vessel anastomosis met with success. The adaptation of endothelium to endothelium is, as we all know, a safe way of preventing coagulation. The danger of coagulation makes the use of a set of small syringes (20 ccm.) imperative for the syringe method, instead of one or two large syringes (200 to 300 ccm.), and thus complicates the method materially.

Any transfusion, in which the normal coagulation time of the blood is considered as an unalterable factor, is apt to be difficult and apt to require a great deal of personal experience and skill. Must we accept this coagulation time as an unchangeable law? Might it not be possible to inhibit the danger of the clotting of the blood during its transfer without diminishing the clinical value of the transferred blood for the recipient? This was the problem to be worked out, and it seemed to me that this problem would be worth a thorough and careful investigation. If solved, blood transfusion, which so far has given only good results in the hands of a limited number, would be changed from a very complicated and difficult method to one of greatest simplicity. Special clinical skill and experience for this work would not longer be required, no haste would be necessary in the performance of transfusion; in short, blood transfusion would be technically as easy as an ordinary saline infusion.

EXPERIMENTS

The problem, then, was to find a chemical substance which would retard the coagulation of the blood for at least thirty minutes, so as to guarantee a safe transfer of the blood without any haste. Furthermore, this substance had to be conditionally atoxic, so that large transfusions of blood (up to 1500 ccm.) could be performed with perfect safety.

Several anticoagulating substances are well known in physiological chemistry and have been used extensively in the laboratories: hirudin (leech extract), sodium citrate, sodium oxalate, peptone, glucose, etc.

My work was commenced by testing hirudin. Hirudin has been used quite extensively in Germany in the treatment of eclampsia. Engelmann[2] reported 14 cases, in which he used up to 0.3 grams of hirudin intravenously without any toxic symptoms. We know from the work of Friedrich[3] that 0.1 gram of hirudin prevents 750 ccm. of blood from coagulating. From a series of experiments on blood received from patients, where a phlebotomy was indicated, it became apparent that the smallest dose of hirudin applicable for our purpose was 0.03 grams of hirudin to 200 cubic centimeters of blood. For the average transfusion of 1000 cubic centimeters we would then use 0.15 grams of hirudin, only half of the dose injected by Engelmann in eclampsia. Preliminary to using hirudin on the human being, I injected up to 0.1 gram of hirudin intravenously into some medium-sized dogs. One dog died four hours after the injection, but we thought this might be due to an overfilling of the circulatory system, as we had diluted 0.1 gram of hirudin with 100 cubic centimeters of saline solution. The other dogs (0.1 gram of hirudin diluted in 20 cubic centimeters of solution) showed no ill effects (after having been observed five days). I then used hirudin on a patient who had an inoperable carcinoma of the stomach (exploratory laparotomy). As she needed a saline infusion the day following the operation, I added 0.1 gram of hirudin (Sachsse) to 500 ccm. of saline solution. The symptoms following this infusion were most alarming; cyanosis and precordial pain set in immediately, followed by a severe chill. Her pulse became

[1] Satterlee and Hooker. Arch. Int. Med., 1914, xiii, 51.

[2] Engelmann. Ztschr. f. Geburtsh. u. Gynäk., 1911, lxviii.

[3] Friedrich. Arch. f. exper. Path. u. Pharmakol., vol. xlix.

almost imperceptible; she was in a precarious condition for over thirty-six hours and recovered only very slowly from this severe reaction.

This experience naturally ended further trials with hirudin. Engelmann's reports might induce other investigators to use comparatively large doses of hirudin for different diseases, and it is just this possibility which has induced me, although the results were negative, to embody in my paper these tests with hirudin as a warning against its use.

After the failure of my experiments with hirudin I took up experiments with sodium citrate to test its possible usefulness for our purpose. When I began my experiments with the citrate method I looked over the current literature, but was unable to find any reference to any work done along these lines. After my work had come to a successful conclusion I found that a paper published by Hustin[1] in May, 1914, had escaped my notice. It appears from this paper that the priority, not only for taking up this problem in a series of animal experiments, but in applying it successfully in a case of human blood transfusion, belongs to Hustin, though his method, as we shall see later, limited its usefulness to small transfusions.

Again, as in my experiments with hirudin, the first series of investigations was carried out with the object of finding the smallest dose of sodium citrate required to keep the blood from clotting for thirty minutes. We[2] took ten test tubes containing 0.1, 0.2, 0.3, etc., up to one cubic centimeter of a 10 per cent solution of sodium citrate. A dog was narcotized and 10 cubic centimeters of blood, taken from his jugular vein, poured into each of the test tubes; another test tube, not containing any citrate, was filled with 10 ccm. of blood. The blood in the first test tube, containing 0.01 sodium citrate to 10 ccm. of blood, clotted just as quickly as the blood in the control; namely, in about five minutes. The blood in the next tube (0.2 per cent) did not clot for two days. On the third day this tube, as well as the next one (0.3 per cent), showed a soft clot, whereas the rest of them (0.4, 0.5 per cent, etc.) were still fluid. These experiments were repeated at different times, always with the same results. The interesting fact elicited from these experiments was that sodium citrate mixed at the rate of 0.1 per cent does not change the coagulation time of the blood, but that a mixture of the sodium citrate with blood at the ratio of 0.2 per cent prevents the blood in the test tubes from clotting for three days. The quantity of citrate needed for this object lies just below 0.15 per cent, but in order to be on the safe side it seems advisable to fix the ratio needed for our purpose as 0.2 per cent. Exactly the same rulings were proved to hold good for human blood.

The next question to be answered was in reference to the toxicity of sodium citrate. If the citrate method was to compete with the older transfusion methods, it had to be applicable to transfusions as large as 1,500 ccm. It was not sufficient to prove that small quantities of blood (that is 200 ccm.) could be transfused with this method without risk to the patient. I am sure that hirudin would have answered the problem if we had expected to transfuse only small quantities. In a great many cases, however—in fact, in the great majority of blood transfusions—it is necessary to transfuse 700 to 1,000 cubic centimeters and sometimes more. The whole method would have only a limited field of usefulness, if we could not use it for large transfusions with perfect safety to the patient.

Sodium citrate can be used with perfect safety at the ratio of 0.2 per cent. Three hundred cubic centimeters of blood were removed from a dog's carotid artery, mixed with sodium citrate (0.06 gram) and reinjected into the jugular vein of the same dog. No ill effect was noticed during the observation time (two weeks). This experiment was repeated a few times with exactly the same result.

On the other hand, sodium citrate is only conditionally atoxic, which means that we cannot inject any unlimited quantity of sodium citrate into the vascular system without running a great risk. This is proved by the following experiments, which differed

[1] Hustin. Ann. et Bull. Soc. Roy. de Soc. Med. et Nat., Bruxelles, 1914, No. 4, 104.

[2] Dr. George Baehr very ably assisted me in these experiments.

from those just described only in so far as the dose of citrate was increased. I took a dog weighing 11 pounds and mixed the blood with 15 ccm. of a 10 per cent solution of sodium citrate. The dog died almost instantaneously. This experiment was repeated twice with exactly the same fatal result. It follows that we have to consider 1.5 grams of sodium citrate as a fatal dose for a dog weighing eleven pounds. Fifteen grams would then be a fatal dose for a patient weighing one hundred and ten pounds. As even 10 grams would nearly reach the fatal limit, it would be utterly impossible to apply this method, if the 1 per cent ratio, as suggested by Weil,[1] would really present the smallest dose of sodium citrate necessary for our purpose. The whole method would then be applicable only for small transfusions (Weil has injected 250 ccm. of blood mixed with 2.5 grams of sodium citrate), and would thus have a rather limited field of usefulness. Hustin also thought, that 0.2 per cent was too small a dose to keep the blood from clotting, and therefore mixed the citrated blood with the same amount of saline solution, adding some glucose, which is a well-known means of retarding coagulation. Here again the adding of an equal amount of saline solution to a given quantity of blood would limit its application to small transfusions (Hustin transfused only 150 ccm. in the one case referred to above); it would not be practical from a clinical standpoint to add 1,000 ccm. of saline solution to a blood transfusion of 1,000 ccm.

The third point of interest, in addition to the questions of dose and toxicity, is the question of the coagulation time of the recipient's blood after the transfusion. We have seen that blood mixed with 0.2 per cent sodium citrate does not clot outside the body in two to three days. If this fact would hold good after the injection of the citrated blood into the recipient, the older, though more complicated methods, would have clinically such an advantage over this method that this paper need not have been written. However, confirming a statement made by Weil at the New York Academy of Medicine, animal experiments and experiences in human blood transfusions show, the most interesting fact, that the same citrated blood, which does not coagulate outside the body in two days, does not retard the coagulation of the general blood volume. On the contrary, the coagulation seems to be temporarily hastened. Three hundred cubic centimeters of blood were taken from a dog, mixed with citrate (0.2 per cent) and reinjected. The time for the coagulation of the normal blood taken before the experiment was started was five minutes. Blood taken from the same dog three minutes after the reinjection of the citrated blood showed that coagulation occurred after only ten seconds. A third test taken three minutes later showed the same result as the second.

This question certainly would lend itself to a further and more detailed investigation. We have not been able to find in our human blood transfusions any marked changes of the coagulation. The marked hastening of the coagulation of the blood, which we found in the dog experiment, does not seem to hold good, at least not to that extent, for human blood. And if it does, it is of such a short duration that it escaped our notice, as most of our coagulation time tests were taken a few hours or the day after the transfusion. There certainly does not exist, however, any marked retarding of the coagulation after a citrate transfusion, a fact which is of the utmost importance for the question of blood transfusion by the citrate method.

TECHNIQUE

Before describing the technique of blood transfusion by the citrate method, I would like to say a few words about the donor, as I consider the proper selection of a suitable donor of the greatest importance. The donor ought to be a strong, husky individual with prominent veins. It is not advisable as a rule to use members of the patient's family, as they are, often, naturally very excited about the condition of the patient and do not stand the loss of blood as well as a professional donor, who offers his blood for a monetary consideration and has no personal interest at stake. I have seen donors who have given

[1] Weil. Discussion, N. Y. Acad. Med., December 17, 1914; J. Am. M. Ass., 1915, lxiv, 425.

up large quantities of blood for transfusion at short intervals — ten to twelve times inside of twelve months. Though no fixed laws can be laid down, it is advisable to refuse donors who have been repeatedly used. It is needless to say that all the preliminary tests (Wassermann, agglutination, hæmolysis, etc.) must be done just as well with the citrate method as with other methods. There is no doubt that the procuring of a donor and the necessary blood tests make transfusion impossible, when needed on the spur of the moment. In exceptional cases (see Case 16) transfusion may be done without the tests; as a rule it is certainly wise to wait for the tests, which can be done in a few hours.

The technique of the citrate method is so simple that it can be dealt with in a few words. The donor is put on a table, a tourniquet applied to the arm, and the vein punctured with a cannula. The blood is received in a sterile graduated glass jar (500 ccm.) containing 25 cubic centimeters of a 2 per cent sterile solution of sodium citrate at the bottom. While the blood is running into the glass receptacle, it is well mixed with the citrate solution by means of a glass rod. After 250 cubic centimeters of blood have been taken another 25 cubic centimeters of citrate solution are added. If less than 500 cubic centimeters of blood are taken (i.e., in infants), the amount of citrate solution added to the blood is reduced accordingly. In cases where we expect to take more than 500 cubic centimeters of blood we have another glass container (500 ccm.) ready to be used in exactly the same manner. The glass jar containing the blood is then put aside and covered with a towel to safeguard against contamination. I have not found it necessary to immerse it in hot water or surround the jar with an asbestos covering. The blood is then taken either into the recipient's room or the recipient is brought into the operating room. I consider it a great advantage that this method does not require donor and recipient to be in the same room; this lessens the psychical shock of the whole procedure for the patient. In fact the donor's blood may be collected in the laboratory or office and carried to the patient's bedside (Kaliski).

Another very great advantage of the citrate method is that as there is no connection between the donor and recipient the donor is safeguarded against contagion of any disease or infection which the patient may have.

The recipient's vein is then punctured or exposed by a small incision; the cannula is introduced and attached to a salvarsan flask or a glass funnel. It is advisable to fill the rubber tubing connection between flask and cannula with some saline solution, so as to prevent air from getting into the circulation. After the connection is made the blood is poured into the salvarsan apparatus. In order to prevent sudden overloading of the circulation it is advisable (especially in larger transfusions) to stop the flow of blood from time to time by compressing the rubber tubing. After the blood has been injected the cannula is removed and the transfusion is thus ended. The whole procedure can be performed with the greatest ease and without any hurry, because the citrated blood, as we have seen above, can be kept for two or three days in the glass jar without danger of clotting.

It is rather immaterial what size needle we use for the injection of the blood; in children, for instance, we can use a very fine Goldenberg or Schreiber needle. But it is of the greatest importance for the successful application of the citrate method that we use a large size cannula in taking the donor's blood. I have lately punctured the vein with a Kaliski[1] cannula (gauge 11, B. & S.), and thus collected 500 cubic centimeters of blood in less than five minutes. The shape and construction of the needle (Lindeman, Kaliski, Unger, etc.) are immaterial so long as one uses one of large caliber. I would like to warn against the use of needles of smaller caliber (for instance, 14 or 16), because if the blood does not shoot out of the vein, and comes out only drop by drop, the blood is apt to clot in the glass jar. I suppose that Zingher,[2] who has lately published a paper, advising a combination of the Lindeman and the citrate method, did not use needles of

[1] Kaliski. Med. Rec., 1915, lxxxvii, 482.
[2] Zingher. Med. Rec., 1915, lxxxvii, 440.

sufficiently large caliber. For if we use needles of sufficiently large caliber, we do not need syringes, which only complicate this method, and certainly are not to be considered as an improvement in the technique.

The 2 per cent citrate solution can be sterilized and resterilized without losing its efficiency. I selected a 2 per cent solution because it simplifies the calculation (30 solution to 300 blood). By varying the percentage one can easily reduce the quantity of solution to be added to the blood. It might be just as advisable, for instance, to add 50 ccm. of a 4 per cent solution to 1,000 ccm. of blood. I have had made up sterile glass tubes (like those for saline solution) containing 50 ccm. of the 2 per cent solution ready for immediate use.

RECORD OF CASES

Case 1. H. M., Mount Sinai Hospital. Clinical diagnosis: Inoperable carcinoma of the stomach and secondary anæmia. January 4, 1915: Hæmoglobin 19 per cent. January 7: Transfusion of 500 ccm. of citrated blood. Hæmoglobin 31 per cent. Polyuria and increased perspiration after the transfusion. Urine macroscopically and microscopically normal. No rise in temperature after transfusion. Hæmoglobin went down during the following ten days to 22 per cent. January 19: Discharged.

Case 2. S. H., Mount Sinai Hospital. Diagnosis: Inoperable carcinoma of the stomach; secondary anæmia. Hæmoglobin before transfusion 26 per cent. January 8: Transfusion of 500 ccm. Hæmoglobin after transfusion 36 per cent. January 18: Hæmoglobin 33 per cent. Second transfusion of 700 ccm. Hæmoglobin after transfusion 42 per cent. January 19: Hæmoglobin 44 per cent.

After the first transfusion moderate polyuria: January 8, 1,750 ccm.; January 9, 1,350 ccm.; January 10, 1,150 ccm. Twenty-four-hour specimen of urine before second transfusion 1,150 ccm., after second transfusion 1,800 ccm. January 19, 900 ccm. Urine showed no albumin, no erythrocytes, no casts. Moderate rise in temperature after both transfusions. Blood picture not changed. January 29: Hæmoglobin 58 per cent.

Case 3. H. T., Mount Sinai Hospital; age 43. Diagnosis: lymphatic leukæmia. January 11: Hæmoglobin 20 per cent; erythrocytes 1,050,000. January 12: Transfusion of 500 ccm of citrated blood. Hæmoglobin 25 per cent. No polyuria.

Test of coagulation time: Just before the transfusion 10 ccm. of blood were taken; this blood showed a soft clot after seven minutes and was firmly clotted after nine minutes. Blood taken from the patient two minutes after transfusion showed a soft clot in two minutes and a firm clot in four minutes. Blood taken six minutes after transfusion showed a soft clot in two minutes and a firm clot in four minutes.

Coagulation time on the day after the transfusion showed soft clot in eight and one-half minutes, firm clot in eleven minutes. These tests show that the shortening of the coagulation time is only of very brief duration and that on the day after the transfusion conditions are again the same as before.

January 13: Hæmoglobin 28 per cent; erythrocytes 1,130,000. January 20: Hæmoglobin 24 per cent. Patient then treated with X-ray and kept on the roof of the hospital. February 28: Hæmoglobin 39 per cent. Patient in very fair condition.

This patient was evidently not benefited by the transfusion, but fresh air and X-ray treatment decidedly improved his condition.

Case 4. B. K., age 18, Beth Israel Hospital. Diagnosis: Purpura hæmorrhagica. Bleeding from nose, throat, gums, and vagina, starting two years ago and lasting a few months. Was well until two months ago; since then same bleeding condition. No blood in urine and stool Temperature ranging between normal and 103° F. Injection of defibrinated blood (10 ccm.) three times.

December 24, 1914: Syringe transfusion. Hæmoglobin rose from 20 per cent to 60 per cent, erythrocytes increased from 1,600,000 to 2,740,000; bleeding persisted without change.

January 15, 1915: Hæmoglobin 30 per cent. Transfusion of 500 ccm. of citrated blood. January 16: Hæmoglobin 45 per cent. No rise in temperature. Coagulation time nine minutes. Bleeding from vagina somewhat less. January 17: Rather profuse vaginal bleeding. January 25: Hæmoglobin 55 per cent; erythrocytes 4,000,000.

Summary: Though the general condition of this patient was improved after the transfusions, neither the syringe nor the citrate transfusions effected any marked change in the purpuric condition. There was some doubt as to whether we were dealing with a case of hæmophilia or purpura hæmorrhagica.

Case 5. H. O., age 5, Mount Sinai Hospital. Diagnosis: Extensive burns. Admitted November 21, 1914. Several plastic operations. On account of the marked anæmia transfusion was advised.

January 20: Transfusion of 150 ccm. Hæmoglobin raised from 42 per cent to 51 per cent. January 22: Hæmoglobin 54 per cent. January 23: Hæmoglobin 58 per cent. January 25: Hæmoglobin 60 per cent. General condition very much improved. Patient looks entirely changed. February 20: Hæmoglobin 46 per cent. Patient had several more plastic operations and general condition ran down again. February 28: Second transfusion of 150 ccm. of citrated blood. Hæmoglobin after transfusion 72 per cent. Patient had a temperature of 102° F., but had had a temperature previously. Coagulation time four minutes. March 1: Coagulation time five minutes. March 10: Hæmoglobin 61 per cent.

Summary. This patient was markedly improved by the transfusions, more so by the first than by the second one. Before the first transfusion the boy was apathetic, pale, and bedridden; a few days after the transfusion he walked around and played with the other children in the ward.

CASE 6. M. C., German Hospital. Clinical diagnosis: Primary anæmia. Hæmoglobin 18 per cent; patient extremely pale; erythrocytes 1,000,000. January 23: Transfusion of 900 ccm. of blood. Hæmoglobin after transfusion 30 per cent; erythrocytes 2,100,000. January 24: Hæmoglobin 36 per cent. Temperature: January 23, 103°; January 24, 100.8°. January 24: Coagulation time three minutes. January 26: Hæmoglobin 45 per cent.

Summary. This patient was greatly benefited by the transfusion and left the hospital within four weeks in excellent general condition.

CASE 7. B. F., Mount Sinai Hospital. Diagnosis: Carcinoma of the stomach; Virchow node present. Patient had had a Satterlee-Hooker transfusion a few weeks before, followed by a very severe reaction (temperature of 104°, chills, etc.). Hæmoglobin 23 per cent. January 24: Transfusion of 700 ccm. of blood. Hæmoglobin after transfusion 27 per cent. January 25: Hæmoglobin 34 per cent. No rise in temperature followed this transfusion, no reaction in any way. Immediately after the transfusion the supraclavicular lymph-node was removed under local anæsthesia by Dr. Lilienthal. Microscopical report: Carcinoma. January 26: Hæmoglobin 39 per cent. January 28: Hæmoglobin 34 per cent. January 29: Patient left the hospital.

This case was interesting mainly in so far as when the node was removed immediately after the transfusion, there was very little bleeding. This case and other cases in this series tend to show that one can safely operate immediately after the citrate transfusion, which is in accord with the experimental findings.

CASE 8. F. M., Post-Graduate Hospital. Diagnosis: Carcinoma of the œsophagus. Previous Jianu-Beck operation. Transfusion advised to put patient in better condition for radical operation.

January 26: Transfusion of 500 ccm. of blood. No rise of temperature. Hæmoglobin rose from 62 per cent to 65 per cent. January 27: Hæmoglobin 68 per cent. January 28: Hæmoglobin 70 per cent; erythrocytes increased from 3,108,000 to 4,320,000. Patient became brighter and mentality was more clear for a week and then became worse again; therefore no radical operation was done. February 20: Died.

CASE 9. M. A., age 19, Lebanon Hospital. Diagnosis: Peliosis rheumatica. Hæmoglobin before transfusion 58 per cent. January 30: Transfusion of 500 ccm. of blood. Hæmoglobin after transfusion 73 per cent. February 1: Hæmoglobin 79 per cent. February 2: Hæmoglobin 75 per cent. Rise in temperature to 101° after transfusion. Coagulation time before transfusion 8 minutes; coagulation time five minutes after transfusion seven minutes; coagulation time one day after transfusion seven minutes.

Summary. The clinical status was not changed by the transfusion. The hæmorrhages stopped for about one week after the transfusion, but began again after this short interval. As remissions occurred in all these cases of hæmorrhagic diatheses, we are hardly justified in ascribing this interval to the blood transfusion. We have to assume that this case was not materially influenced by the transfusion. It is possible that frequent transfusions might have been better for this boy.

CASE 10. M. S., age 22, Roosevelt Hospital. Diagnosis: Adenocarcinoma of rectum.

February 11: Transfusion of 800 ccm. of blood. Hæmoglobin before transfusion 38 per cent; erythrocytes 3,600,000. Hæmoglobin after transfusion 50 per cent; erythrocytes 4,300,000. February 12: Hæmoglobin 55 per cent. February 16: Exploratory operation was done. The tumor was found to be inoperable.

The indication for transfusion preliminary to a major operation seems to be a very good one, especially when the patients are cachectic. They thus have a much better chance to stand a major surigcal operation.

CASE 11. L. S., age 23, Mount Sinai Hospital. Antecedent history of frequent tonsillitis; during the last five months very profuse menstrual periods, no bleeding from uterus between periods; also bleeding from nose and gums; probably some purpuric condition on the basis of chronic tonsillar infection. February 12: Transfusion of 300 ccm. of citrated blood. Hæmoglobin before transfusion 19 per cent; after transfusion 30 per cent. February 15: Hæmoglobin 35 per cent. February 16: Menstruation started; quantity not changed by transfusion. February 21: Hæmoglobin 28 per cent; February 27, 35 per cent; March 1, 41 per cent; March 3, 46 per cent; March 6, 51 per cent. March 20: 10 ccm. of a 10 per cent solution sodium citrate injected intravenously. March 22: Again profuse bleeding.

Summary. Patient's general condition very much improved (open-air treatment). The purpuric condition was evidently not influenced by the transfusion, though the hæmoglobin continued to rise very markedly after the transfusion (from 30 per cent to 51 per cent). It is interesting to note that two days after the intravenous injection of 10 ccm. of a 10 per cent sodium citrate solution the patient had a very profuse menstrual period.

CASE 12. E. K., age 3, Mount Sinai Hospital. Hæmorrhages from intestinal tract, probably ulcus pylori, following a two-hours' anæsthesia for con-

genital dislocation of hip. April, 1914: Six attacks of hæmatemesis (first hæmatemesis one month after operation). August, 1914: Hæmoglobin 12 per cent. Transfusion (syringe method by Dr. Hyman). Hæmoglobin raised to 48 per cent. Patient left the hospital in good condition.

Readmitted February 7: Hæmoglobin 28 per cent. Profuse hæmorrhages. February 15: Transfusion of 200 ccm. of citrated blood from father. Hæmoglobin after transfusion 33 per cent. February 16: Vomited another blood clot. February 17: Stools still tarry, strongly positive for blood. February 21: Hæmoglobin 12 per cent. Transfusion followed by exploratory laparotomy decided upon. Another transfusion from father to child was attempted. The father, who was a very nervous and rather weak individual, proved to be a very poor donor this time. Though a large vein was exposed and a good size needle introduced, the blood ran out very slowly, drop by drop, and partly clotted in the glass jar. The venesection was abandoned after 100 ccm. had been taken, and we decided to procure a good donor. February 22: Transfusion of 450 ccm. of citrated blood. Immediately after transfusion exploratory laparotomy with negative findings. No reaction followed transfusion. Hæmoglobin raised from 14 per cent to 37 per cent. February 23: Hæmoglobin 50 per cent; February 26, 45 per cent; February 28, 28 per cent. Bleeding since February 26. March 3: Hæmoglobin 17 per cent. Third transfusion, 350 ccm., given by Dr. Unger with his apparatus. Hæmoglobin raised to 46 per cent. Bleeding continued for three days, then stopped. March 20: Hæmoglobin 34 per cent. Bleeding has stopped. Child, though still very anæmic, is improved.

Bleeding time February 23, 9 minutes; coagulation time 6 minutes. Bleeding time February 28, 11 minutes; coagulation time 5 minutes. Bleeding time March 3, 8 minutes; coagulation time 7 minutes. Bleeding time March 5, 14 minutes.

April 2: Another very profuse hæmorrhage from the stomach; blood in stools; child very anæmic.

Summary. The child had a syringe transfusion in August, 1914, after which the bleeding stopped. She then gained rapidly in general health and was perfectly well for 6 months, when the symptoms recurred. She had two transfusions by the citrate method in February, 1915, which failed to stop the bleeding. As the syringe transfusion (August, 1914) had been of far greater benefit to the child than the two citrate transfusions (February, 1915), it seemed advisable to give the child another transfusion of non-citrated blood. But the absence of a good clinical result after the two citrate transfusions was evidently not a fault of the method, but was based on the fact that her disease had progressed, for the syringe transfusion (March, 1915) did not improve her general condition very markedly, and was certainly far less beneficial than the syringe transfusion in April, 1914. It is interesting to note the large quantities of blood given to this little girl without overburdening her circulation.

CASE 13. M. R., Mount Sinai Hospital. Clinical diagnosis: Bleeding gastric ulcer; acute profuse hæmorrhage. Pulse 140. Hæmoglobin 35 per cent. February 19: Transfusion of 800 ccm. of blood. Hæmoglobin 55 per cent.

February 20: Another profuse hæmorrhage. Hæmoglobin down to 32 per cent. Second transfusion of 800 ccm. of blood (preliminary to exploratory laparotomy). Hæmoglobin raised to 53 per cent. Laparotomy (Dr. Moschcowitz): A thorough examination of stomach and duodenum failed to show evidences of an ulcer. Gastroenterostomy and pyloric exclusion.

February 22: Hæmoglobin 62 per cent. Coagulation time four and one-half minutes. No rise in temperature above 100.5° after any of the transfusions.

February 23: Another alarming hæmorrhage into the stomach. This was stopped after a stomach wash with ice water. From this time on no further bleeding. Perfect recovery.

Summary. Though the hæmorrhages did not stop after the transfusions, the patient was decidedly benefited by the transfusions and stood the operation very well. It is worthy of note that in this case an extensive operation was done immediately after the transfusion without any untoward symptoms. The bleeding was certainly not more than normal. This patient received 1,600 ccm. of citrated blood (representing over 3 grams of sodium citrate) inside of twenty-four hours without showing any reaction.

CASE 14. J. S., Mount Sinai Hospital. One year ago appendectomy; since then symptoms of pylephlebitis. General debility, anæmia, sepsis. Temperature ranging between 100° and 103°. Hæmoglobin 35 per cent.

February 22: Transfusion of 1,000 ccm. of blood. Hæmoglobin 50 per cent. One chill of short duration after the transfusion. February 27: Incision of liver abscess (actinomycosis): Dr. Brickner. March 4: Died.

Post-mortem examination: Multiple actinomycotic abscesses of the liver. Perforations into the lung and pericardium.

CASE 15. F. R., age 30, Mount Sinai Hospital. Clinical diagnosis: Post-partum sepsis. Blood culture positive (streptococcus).

February 23: Transfusion of 250 ccm.; vein punctured with Goldenberg needle. Hæmoglobin 76 per cent (as before transfusion). February 27: Second transfusion: 250 ccm. of blood removed from patient and 450 ccm. of citrated blood introduced.

While patient had shown no reaction after the first transfusion, she had a chill after the second transfusion; the pulse was rapid and poor, requiring stimulation. February 28: Patient improved considerably. March 4: Went home against advice. March 6: Died.

This case was a hopeless one. Blood transfusion has been frequently suggested and practiced in cases of general infections. In this case of puerperal sepsis the treatment was of no avail.

CASE 16. J. D., age 26, Fordham Hospital. No family or previous history of bleeding. For three weeks profuse bleeding from rectum, gums, nose. Hæmoglobin is so low that it cannot be ascertained. On account of the very poor condition of the patient, the usual tests of the donor's blood were dispensed with.

February 28: Transfusion of 500 ccm. of citrated blood. Hæmoglobin 30 per cent. Practically no reaction; no increase in temperature; no chills; no polyuria. Patient's condition very good for four days (stopped bleeding). Renewed hæmorrhages on the fifth day.

March 5: Hæmoglobin 25 per cent. March 6: Bleeding from nose and gums. March 7: Hœmoglobin 15 per cent.

Another transfusion was advised, but the patient left the hospital against advice.

CASE 17. E. H., Presbyterian Hospital. Carcinoma of the uterus for three years. Transfusion preparatory to operation. Hæmoglobin 35 per cent.

March 17: Transfusion of 450 ccm. Hæmoglobin 45 per cent. Severe chill and rise of temperature to 103° followed the transfusion; the next day temperature normal. Coagulation time practically normal. March 23: Exploratory laparotomy (Dr. Hawkes): inoperable carcinoma.

Summary. I saw the patient after the operation. The transfusion had certainly improved the general condition very markedly. Whereas she was very pale before the transfusion she now had a very good color and looked much stronger.

CASE 18. L. P., age 18, New York Infirmary. Admitted December 20, 1914. Most profuse bleeding from uterus at menstrual periods only; bleeding lasting from two to three weeks, possibly a purpuric condition.

January 6: Syringe transfusion (by Drs. Kaliski and Ottenberg). Transfusion of 670 ccm. of blood. Hæmoglobin raised from 28 per cent to 35 per cent and then rose automatically to 65 per cent. Rise in temperature to 104° following the transfusion. The bleeding was not changed by the transfusion and the hæmoglobin fell to 17 per cent. March 18: Second transfusion (citrate method), 500 ccm. of blood being transfused. Hæmoglobin raised to 23 per cent. Temperature rose to 102° after the transfusion, and the patient ran temperatures for ten days, probably due to an infection of the arm at the site of the phlebotomy and to an intercurrent otitis media. March 30: Condition now improving.

Summary. This patient was more benefited in her general condition by the first transfusion than by the second transfusion, though none of the transfusions changed the metrorrhagia. Possibly the first donor was better suited for this particular patient than the second one.

CONCLUSIONS

I have intentionally given a rather detailed account of the cases in order that the reader may be enabled to form his own opinion concerning the merits of the citrate method. I have embodied in this list only those cases in which the transfusion was performed by me and which I had occasion to follow up after the transfusion. I have not included half a dozen cases done by others of which I have personal knowledge; the results of this new method seem to have been just as satisfactory in the hands of others as in my own. They all seem to welcome the easy and safe way with which transfusion can be performed.

The clinical material of this review of 22 citrate transfusions in 18 cases is comprised of the following cases: Inoperable carcinoma, 3 cases; preoperative transfusions, 3 cases; purpura hæmorrhagica and allied conditions, 5 cases; lymphatic leukæmia, 1 case; severe anæmia, 2 cases; gastric hæmorrhage, 2 cases; actinomycosis, 1 case; puerperal sepsis, 1 case. Out of these 18 cases 4 were transfused twice within short intervals.

All the points of clinical interest have been discussed in the records of the cases. However, I would like to dwell on some which are of importance, not only in regard to the citrate method but in reference to any human blood transfusion.

Some of the cases showed a rather marked polyuria lasting twenty-four hours, though I must say that this increased excretion of urine appeared only in a small percentage; none of the cases showed any macroscopical or microscopical changes in the urine. A marked rise of temperature was noted in 5 cases, 3 of which were accompanied by a chill after the transfusion. It is possible that some rises in temperature escaped our notice, as the patients were running septic temperatures before the transfusions. It is a well-known fact that chills following transfusion, or even simple saline infusions, occur rather frequently (Lindeman[1] had 22 chills

[1]Lindeman. J. Am. M. Ass. 1914.

in a series of 62 cases). In our series chills were observed in three cases out of twenty-two transfusions.

A good indicator of an effective transfusion of blood is the automatic rise of the hæmoglobin after the transfusion. For instance, by a transfusion we raise the hæmoglobin of the patient from 20 per cent to 40 per cent, and we notice during the following week that the hæmoglobin goes up automatically another 10 to 12 per cent. This rise of the hæmoglobin was noticed in a large number of our cases and is a proof of the good clinical value of the citrated blood.

The question of the coagulation time has been discussed above. If the hastening of coagulation after the injection of citrated blood, as apparent from animal experiments and some experiences on the human being, were to last any length of time, it would be of the greatest value in different hæmorrhagic conditions (especially hæmophilia). The shortening of the coagulation time is, however, of such a transitory nature, the clinical conditions existing before the transfusions are reëstablished so quickly, that we cannot expect any greater help for these diseases from the citrate method than from any other method of transfusion.

It would be very tempting to enter upon the broad question of the indications calling for blood transfusions. This paper, however, was written mainly to advocate a new method of transfusion, and a thorough investigation of these indications would go beyond its scope. Furthermore, Ottenberg and Libman[1] have taken up this subject in an admirable paper on "Blood Transfusions, Indications, Results, General Management," which will be published in the near future. Their paper, based on experiences in 212 cases of blood transfusions, dwells upon all the interesting factors of this subject. It must be considered as one of the most valuable publications in this field.

Transfusion of blood, as we have seen above, had a very varied career in our medical armamentarium. Though practically forgotten for nearly a century, it has been revived in the last decade, and on account of great improvements in the technique (uppermost among them the blood tests for agglutination and hæmolysis) transfusion is now to be considered a safe method, yielding excellent results in properly selected cases. The success of transfusions is most striking in profuse hæmorrhage (ulcer of the stomach and duodenum, ectopic pregnancy, typhoid and cholæmic hæmorrhages, etc.), in different forms of poisoning, and in some hæmorrhagic conditions. It produces excellent and lasting results in cases of primary and secondary anæmia, whereas improvements following transfusions in different forms of leukæmia and pernicious anæmia are not as a rule of a lasting character. I think transfusion ought to be practiced much more than heretofore as a preparatory step in cachectic patients who are to undergo extensive operations. Operative shock seems to be a promising field, though the experiences of Ottenberg and Libman are not very encouraging. Though a great deal has been written on this subject in the last year, some of the indications for transfusion in sepsis and tuberculosis are still very questionable. If we approach the question of transfusion without too great an optimism on the one hand and without being overskeptical on the other hand, we are sure to make progress in this most interesting field. Transfusion is not a panacea for every disease, but it certainly has a wide field of usefulness.

I am well aware that this new method of transfusion has to be tested on a much larger scale before definite judgment can be passed upon it. However, I think that the reports given above are sufficiently encouraging to induce the profession to give this method a fair trial. I feel assured that the citrate method has come to stay. Clinically, it appears to be as good as any of the older methods, and at the same time it has the advantage of the utmost simplicity.

[1] Ottenberg and Libman. New York Academy of Medicine December 17, 1914.

A PLASTIC OPERATION FOR BUYO CHEEK CANCER IN ITS EARLY STAGE AND A FURTHER REPORT OF BUYO CHEEK CANCER CASES

By GEORGE G. DAVIS, A.B., M.D., Chicago
Formerly Associate Professor of Surgery, University of the Philippines; and Surgeon, Philippine General Hospital, Manila

IN a former paper[1] the writer has rather fully considered the subject of buyo cheek cancer, describing the buyo chew, which consists of a mixture of the buyo leaf, betel nut, lime, and tobacco, as a definite etiological factor in the production of cancer of the cheek, discussing in that paper the symptomatology, pathology, and prognosis, and lightly touching on the treatment of buyo cheek cancer.

It is the purpose of this paper to present a plastic operation for early buyo cheek cancer which the writer has employed with satisfactory results, and to report further cases of buyo cheek cancer which have come to the writer's service at the Philippine General Hospital since the last paper was presented.

The pathological lesion which this operation aims to meet is an epithelioma which occurs on the inner aspect of the cheek, where the buyo chew is held, and the regional submaxillary lymphatic glands, which may become the seat of metastasis (Fig. 1).

Anatomically the approach to the growth presents some difficulty, as the epithelioma often extends posteriorly to the level of the last tooth. The seventh nerve and preservation of the cosmetic appearance of the face make a radical procedure with happy results a rather complex one.

The exposure of the inner aspect of the cheek must be sufficient to allow the operator to see clearly the field of operation as far posteriorly as the last tooth. The seventh nerve should be avoided to prevent a subsequent facial paralysis. The best future cosmetic appearance after the operation is greatly to be desired, especially in women. Another problem is the covering of the defect of the mucosa and underlying tissue after removal of the growth.

The operation here described meets the pathological condition if the growth is still in the early stage, before the entire thickness of the cheek is involved, and, anatomically, the important structures are spared and the expression and contour of the face and the cosmetic appearance are but slightly impaired.

The incisions employed in this operation may for convenience of description be divided into three groups: First, a cut is made from the angle of the mouth to the lower border of the ramus of the jaw and extending to the angle. The aim of this is to give access for removal of the growth within the oral cavity and by the same procedure to expose the submaxillary lymphatic glands. A second circular incision is made on the side of the neck to form a flap with pedicle or hinge to cover the defect of mucosa caused by the removal of the growth and thus give an epithelial lining within the oral cavity. The third group of incisions is made lower down on the neck to form flaps to slide up and cover the area denuded by the turning up of the circular flap.

The first incision (Fig. 2, 1-2-3) extends from the angle of the mouth downward and slightly posteriorly to the lower border of the ramus of the jaw, then posteriorly to the angle. The hæmorrhage from the labial artery is controlled by placing two curved hæmostats on the lip and cutting between them. The entire thickness of the lip and lower cheek is incised down to and along the ramus to the angle of the jaw, sparing, however, the facial artery. The cheek is now elevated and everted and the malignant growth well exposed, giving an unobstructed view to the most posterior limits. A circular incision of the growth is now made, care being taken to cut wide of the margin of the epithelioma. The growth and a portion of healthy or uninvolved underlying tissue is excised, leaving a circular defect in the mucosa and underlying tissue of the cheek.

The second incision (Figs. 2 and 3, *c-a-b-d*)

[1] Davis, George G. J. Am. M. Ass., 1915, lxiv, 711.

is circular in shape or cut to correspond to the defect made on the inner aspect of the cheek. This skin-flap is dissected from the underlying tissue except at the line *c-d*, which is left intact and used as a pedicle or hinge. This flap is turned into the mouth, using the portion *c-d* as a hinge, thus bringing the skin surface of the flap toward the oral cavity and the cut surface of flap next to the cut surface of the cheek made by removal of the epithelioma, the line *c-d* now forming the lower portion of the flap and *a-b* the upper border in its new position.

The edges of the skin-flap are now sewed to the edges of the mucous membrane of the cheek, which has been approximated to the upturned flap, and the skin-flap thus forms an epithelial lining for the mouth at the site where the growth was removed. The regional submaxillary lymphatic glands are now readily removed.

The third incision aims to close the defect of skin on the side of the neck caused by the turning up of the circular flap *c-a-b-d*. This is effected by an inverted Y-incision (Fig. 3, *a-e-f* and *b-e-g*). The two flaps *a-e-f* and *b-e-g* are now undermined and slid upward to the original line, 1-2-3, below the ramus of the jaw (Figs. 3 and 4).

This operation, of course, is only indicated in early cases when the growth is more or less limited to the mucous surface of the cheek. The result is good. The seventh nerve is not injured, the facial expression is preserved, and but a single line from the angle of the mouth mars the cosmetic appearance of the face. A high collar readily shields the neck scars.

The question of choice of anæsthesia employed in this operation is of importance, as the chance of a subsequent aspiration pneumonia caused by the inhalation of blood, which is of necessity more or less copious, is great with an improperly applied anæsthesia.

The writer has employed whisky, morphine, and ether. One-half hour before the operation one-fourth grain of morphine is given hypodermatically and an ounce of whisky is taken by mouth. The patient is then put well under the ether anæsthesia. When the operation is started the ether anæsthesia is stopped and not used further. The skin incisions are then made, during which time there is no hæmorrhage into the oral cavity.

Fig. 1. A case of buyo cheek cancer (Series No. 78), showing the growth in its classical site and the blackening of the teeth. This patient is 74 years old and has chewed buyo for 62 years, during which time he always held the chew next to the left cheek in a position corresponding to the site of the present lesion. Photograph by the Bureau of Science. The patient is from the writer's service at the Philippine General Hospital, Manila.

The patient now partly comes out from under the ether as the operator is excising the growth within the oral cavity, and the patient is able to spit out or reflexly cough up any blood finding its way into the respiratory passages. The patient is able to understand the orders of the operator and will spit out or cough up the blood or hold his head in a convenient position as told, but suffers during this period no sensation of pain. Thus we have a minimum of ether anæsthesia and of aspiration of blood.

Since presenting a paper on "Buyo Cheek Cancer," which was a study of seventy-five cases of oral cancer with special reference to cheek cancer and its etiology, the writer has had four more cases which are reported as follows:

Of the 75 cases of oral cancer previously reported, 49 were in the cheek. With these 4 cases we have a series of 53 cheek cancer cases.

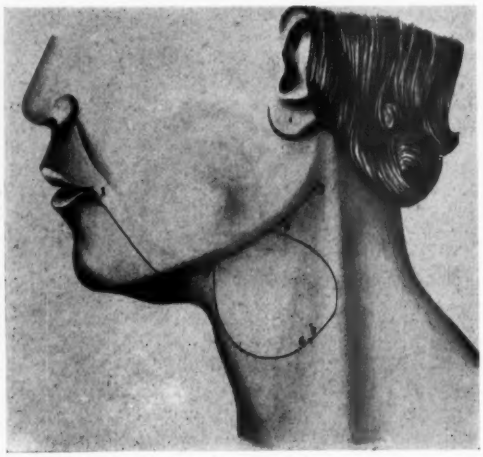

Fig. 2. This drawing shows the skin incisions employed in the plastic operation for buyo cheek cancer in its early stage. The incision 1-2-3 is made first. This flap when turned up gives access to the new-growth. The plastic flap *c-a-b-d* is then made. The flap *c-a-b-d* is to be used to cover the defect in the mucosa and underlying tissue resulting from the excision of the new-growth. The portion of the flap *c-d* is used as a pedicle or hinge when the skin flap is turned up.

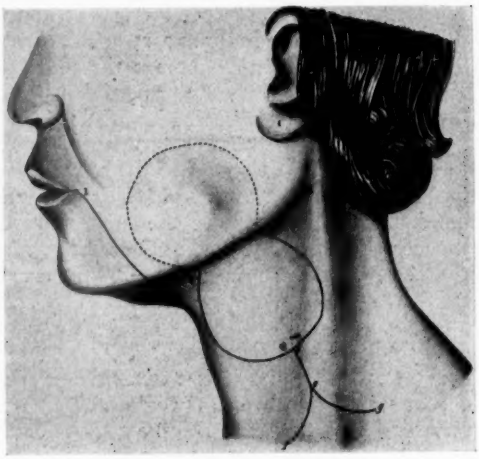

Fig. 3. This drawing shows the first incision, 1-2-3, made to give access to the growth, and the second incision *c-a-b-d*, the skin of which is undermined and turned back as a flap, using *c-d* as a pedicle or hinge to cover the defect in the cheek made by removal of the growth and is represented in its new position by the dotted lines, and the third incisions *a-e-f* and *b-e-g* which are made to form flaps to cover the defect, resulting from the turning up of the flap *c-a-b-d*.

The observations and conclusions made in reporting the former cases are well borne out in the further study of these cases. Here we have a definite history of buyo-chewing extending over a long period, varying in this series from 28 to 70 years. The occurrence is in patients of advanced years and the site of the lesion corresponds to the position in which the buyo chew was held.

That the lime is the active agent in the production of these epitheliomata the writer is convinced by a further study of the use of the same lime as is used in the buyo chew in producing the "fuente."

"Fuente" is a Spanish word and literally means "fountain." It is not an uncommon custom among the islanders in cases of chronic open ulcers of tuberculous, luetic, or chronic pyogenic origin, or in leprosy lesions, to produce the "fuente." As the ancient Greeks used the seton to allow the escape of evil humors so too the "fuente" is made to form a "fountain" for the escape of pus, or as a counter-irritant, and thus to exert a kindly influence upon the troublesome lesions.

The "fuente" is produced by the application of lime-and-soap. A large buyo leaf, in the center of which is a hole, the size corresponding to the desired size of the "fuente," which is generally two or three centimeters, is applied over the portion of the anatomy where the "fuente" is desired. For lesions of the neck and upper extremity the lateral aspect of the upper arm is often selected, and the inner aspect of the thigh is selected in cases where the lesion is in the leg.

The lime-and-soap, in the form of a paste, is applied to the skin through the hole in the buyo leaf which has been placed over the skin. A dressing and bandage is then applied. This is sometimes preceded by a scarification or burning with a cigar tip.

After a few days of constant application of and irritation by the lime-and-soap, the skin becomes ulcerated through its entire thickness and the underlying muscle comes into view. The wound is now kept open by introducing a small round ball of wood which is held in place by a bandage, and thus a "fuente" or a continuous discharge of pus results. Thus

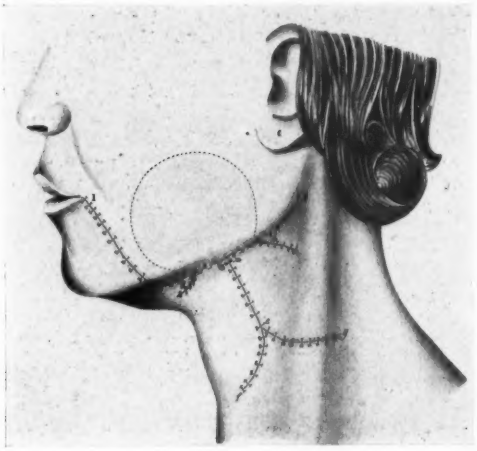

Fig. 4. This drawing shows the incision 1-2-3 sutured. The flap turned up from the neck into the mouth is represented by the dotted lines, and the pedicle or hinge by the line *c-d*. The flaps *a-e-f* and *b-e-g* are slid up to the line 1-2-3 to cover the defect caused by the turning up of the flap *c-a-b-d*.

we have an ulcer resulting from a chemical irritant, the lime, quite independent of any mechanical agent.

This point is brought out to emphasize the statement made by the writer in a previous paper that the active agent of the buyo chew which produced the "buyo cheek cancer" was the lime constituent of the chew.

Series No. 76, Hospital F. No. 3325, 1914, age 80, male. Chewed buyo 70 years; lesion on right cheek where buyo was held in mouth. Present illness began one year ago as a small ulcer on the inner aspect of the right cheek near the angle of the mouth. This gradually enlarged and became quite painful, especially when irritated by food. Examination of the localized lesion: An irregular, rough, red, tender, slightly elevated growth with raised border is situated on inner aspect of the cheek near the angle of the mouth. This is about 3 cm. in diameter. The regional submaxillary lymphatic glands are enlarged and hard. Diagnosis: Epithelioma of the cheek with regional metastasis in submaxillary lymphatic glands.

Series No. 77, Hospital F. No. 3598, 1914, age 40, female. Chewed buyo 28 years; lesion on left cheek where buyo was held in mouth. Present illness: Ten months ago the patient noted a small, round enlargement on buccal mucosa of the left cheek. This gradually enlarged. One week ago this became ulcerated. She suffers slight pain when food touches the growth. Examination of the

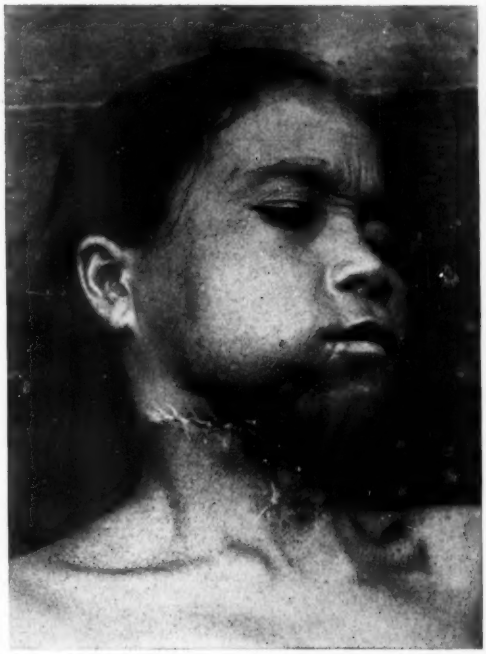

Fig. 5. Photograph of a patient upon whom this operation was performed. The final arrangement of flaps is same as is diagrammatically represented in Fig. 4. Photograph by the Bureau of Science. The patient is from the writer's service at the Philippine General Hospital, Manila.

localized lesion: On buccal mucosa of the left cheek is an ulcerated area, irregular in shape, and about 2 cm. in diameter. The edges are clean-cut and elevated. There is induration in the surrounding tissue. The submaxillary lymph-glands are enlarged and indurated. Diagnosis: Epithelioma of the cheek with regional metastasis in the submaxillary lymphatic glands.

Series No. 78, Hospital F. No. 4211, 1914, age 74, married, male. Chewed buyo 62 years; lesion on left cheek where buyo was held in mouth. The patient began chewing buyo when ten years old. He held the buyo on the left side until the present trouble appeared. Since, he has held the chew on the right side; that is, he held the chew at the site of present lesion for a period of 62 years. (See Fig. 1.) Present illness: Began two years ago, when he first noted a small, elevated, white area on the inner aspect of the left cheek, located about the center of the cheek. At first it was not painful, but at present it is. The growth has gradually enlarged. Examination of the localized lesion: On the inner aspect of the posterior half of the left cheek, extending from the center of the cheek to the posterior portion of the cheek and downward;

encroaching upon the mucosa of the lower alveolar process is an elevated, irregular, rough, white non-ulcerated growth. The submaxillary lymph-glands are enlarged and indurated. Diagnosis: Epithelioma of the cheek with regional metastasis in the submaxillary lymphatic glands.

Series No. 79, Hospital F. 4108, 1914, age 80, white, male. Chewed buyo 60 years; lesion on left cheek and left lower gum where buyo was held in mouth. Present illness: Two months ago the patient first noted a swelling in the right lower gum, which later extended to the adjacent portion of the right cheek. Examination of the localized lesion: All his teeth are gone and at the middle portion of the right gum is an irregular, rough growth which is about two inches long, and encroaches upon the right cheek. The right submaxillary lymphatic glands are enlarged and indurated. Diagnosis: Epithelioma of the left cheek and gum, with regional metastasis in the submaxillary lympathic glands.

PULSION DIVERTICULUM OF THE ŒSOPHAGUS

A New Operation for Its Cure

By OTTO C. GAUB, M.D., F.A.C.S., and CHEVALIER JACKSON, M.D., F.A.C.S., Pittsburgh.

As shown by the case illustrated in Figs. 1 and 2, a pulsion diverticulum if not removed increases in size until it becomes a serious menace to the patient's health and even life, by the dysphagia due to the compressive stenosis caused by the sac into which food first enters in each attempt at deglutition. So far as known at present the only treatment worthy of consideration is operative extirpation. This seems, when looking at a radiograph such as that reproduced in Fig. 2, to be a very easy procedure. It must be remembered, however, that the radiograph is taken with the diverticulum full of food, while the operation must necessarily be done with the diverticulum empty. When empty, a small diverticulum has escaped the search of some of the most careful surgeons. Furthermore, the extent of removal must be determined to a nicety, for, if insufficient, the patient will not be relieved of the symptoms and the diverticulum will recur.[1] On the other hand, if the removal takes more than simply the redundancy a stricture of the œsophagus may leave the patient worse off than before. Obviously, it is impossible to bring the œsophagus up into the external wound for inspection and operative manipulation as can be done with the intestine in an abdominal operation. Pulsion diverticula occur only in patients past middle life. Most cases are decidedly senile and nearly all are more or less weakened from the prolonged mechanical interference with deglutition. More than half the cases present symptoms of chronic bronchitis. All of these factors render patients suffering with pulsion diverticula bad subjects for the prolonged and tedious operation of extirpation as heretofore practised. The herein-described method has reduced the duration of the operation more than one-half and has given to the procedure a precision and certainty never before attainable.

Anæsthesia. For the extirpation of diverticula, insufflation intratracheal ether anæsthesia should always be used because respiration is very likely to be interfered with by traction on the œsophagus during the dissection or in the pulling out of the sac, or respiration may be interfered with by adductor spasm of the vocal cords due to irritation of the recurrent or of the pneumogastric. Moreover, the anæsthetist is far removed from the field of operation.

Technique. The external part of the technique does not differ materially from the classical operation. It may be well, however, to remind the surgeon of the following points:

1. The landmark to bear in mind is the cricoid cartilage.

2. A large vertical extent of wound must be maintained and must be kept clean and dry

[1] In one case of recurrence seen by one of us the recurrence was in the form of two pouches, one on each side of the previous operation which had been done by a very skilliful surgeon.

Fig. 1. Pulsion diverticulum filled with bismuth mixture in a man aged 46 years. (Radiographed by Dr. Russell H. Boggs.)

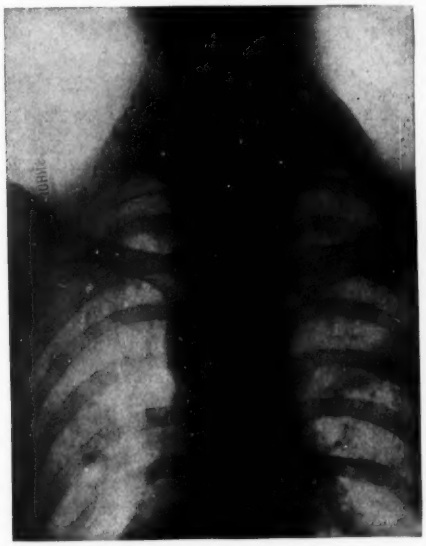

Fig. 2. Same patient as Fig. 1, four years later, the patient having declined operation. The great increase in size is usual in untreated cases. (Radiograph made by Dr. George C. Johnston.)

by careful hæmostasis at all stages of the procedure.

3. The cricoid cartilage and the subjacent rings of the trachea must be seen and identified.

4. The œsophagus will be discovered posteriorly to the cricoid and trachea as a thin flat fold pressed against the cervical vertebræ.

In the new operation, having exposed the œsophagus, the surgeon asks the œsophagoscopist to push out the diverticulum into the external wound. The surgeon seizes the bottom of the pouch with forceps (Fig. 3). He then asks the œsophagoscopist to insert the œsophagoscope into the subdiverticular lumen of the œsophagus. The surgeon then amputates the redundancy, being careful not to make undue tension in order to determine with precision the amount of tissue which really constitutes redundancy.

Closure of the wound, dressing, and aftercare do not differ after this procedure from that of the usual operation.

The authors have performed this operation upon two patients.

CASE 1. Mrs. D., aged 58 years, referred by Dr. R. W. Fisher for increasing difficulty in swallowing solids. Foul breath and a cough were annoying at times. Patient had "ulcerated sore throat" four years before. Swallowing symptoms were of one year's duration. There had been no regurgitation. Examination with the œsophagoscope, without anæsthesia, general or local, showed a small diverticulum anterior to the œsophagus and slightly to the left. Withdrawal of the œsophagoscope revealed the orifice of the subdiverticular œsophagus anteriorly to the right, covered with a fold of mucosa. The ridge between this orifice and the diverticular orifice was cicatricial (Fig. 4, D). The subdiverticular orifice was easily entered with the beak of the slanted-end œsophagoscope but would not permit the entire end to enter readily. The tube-mouth was carefully used to stretch the cicatricially contracted orifice and to permit the œsophagoscope to enter freely. At œsophagoscopy seventeen days later without anæsthesia the œsophagoscope entered readily without any sign of recurrence of stenosis, but the diverticulum remained, objectively, as well as subjectively, the same as before dilatation of the stricture. Radiography by Dr. George C. Johnston showed the diverticulum (Fig. 6). External operation by the method above outlined, and illustrated in the schema (Fig. 3), was

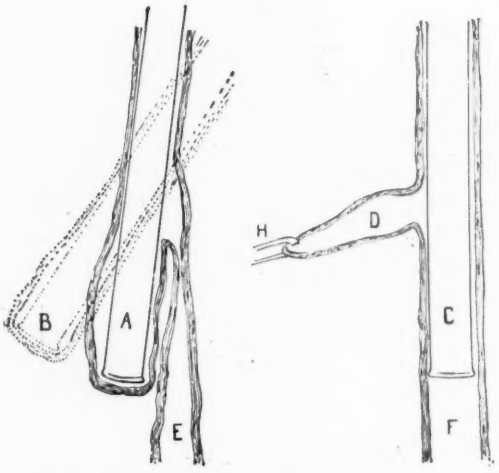

Fig. 3. Schematic representation of œsophagoscopic aid in the excision of a diverticulum. At A the œsophagoscope is represented in the bottom of the pouch after the surgeon has cut down to where he can feel the œsophagoscope. Then the œsophagoscopist causes the pouch to protrude as shown by the dotted line at B. After the surgeon has dissected the sac entirely loose from its surroundings, traction is made upon the sac as shown at H and the œsophagoscope is inserted down the lumen of the subdiverticular œsophagus as shown at C. The œsophagoscope now occupies the lumen which the patient will need for swallowing. It only remains for the surgeon to remove the redundancy, without risk of removing any of the normal wall.

done by Dr. Gaub, assisted œsophagoscopically by Dr. Jackson. The neck of the sac was ligated and transfixed when the œsophagoscope was withdrawn and each puckered spot of suture was seen, as shown by the sketch (Fig. 4, B). The stump externally was lightly touched with pure carbolic acid,

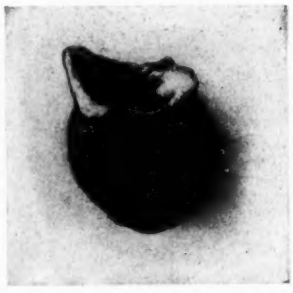

Fig. 5. Pulsion diverticulum of the œsophagus removed from a man aged 67 years, whose radiograph is shown in Fig. 7 (Case 2).

and supporting sutures were inserted. Feeding was by catheter inserted at œsophagoscopy. Firm reunion and prompt recovery followed. One year later the patient was swallowing perfectly.

CASE 2. Mr. S., aged 67 years, was referred by Dr. David Reisman and Dr. Walter J. Freeman of Philadelphia. They had made the diagnosis of diverticulum and had had the radiograph (Fig. 7), made by Dr. H. K. Pancoast. Severe cough, purulent expectoration, and difficulty in swallowing had made the patient's life miserable for the past year. Œsophagoscopy by one of us confirmed the diagnosis of Drs. Reisman and Freeman, the findings coinciding with the radiograph of Dr. Pancoast. The subdiverticular orifice (Fig. 4, C) was easily entered with the slanted-end œsophagoscope. There were no signs of cicatrices or inflammatory processes. The orifice of the pouch, just as the œsophagoscopic tube-mouth emerged from it, was circular in outline and rolled over at the margin (Fig. 4, B). The operation, as shown in the schema (Fig. 3), was done by Dr. Gaub, with the œsophagoscopic assistance of Dr. Jackson. The pouch after

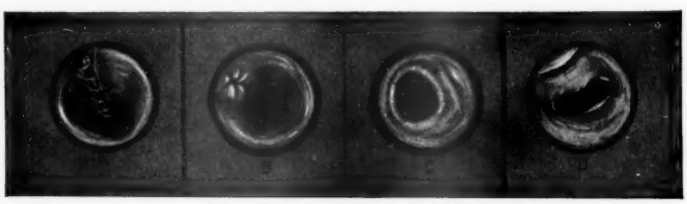

Fig. 4. Œsophagoscopic views in cases of diverticulum. Patient recumbent. A, endoscopic view of linear suture after amputation of the diverticulum. B, after suture by ligation and transfixation in another case. C, view looking into pouch after partial withdrawal of the œsophagoscope in a man aged 67 years (Case 2). Slitlike orifice of subdiverticular œsophagus seen in upper right quadrant. D, view of diverticular orifice in case of a woman of 58 years of age (Case 1). Subdiverticular orifice overhung by a fold in the upper left quadrant. The ledge between the orifice and the diverticular opening, supported by the orbicular fibers of the cricopharyngeus, is cicatricial.

Fig. 6. Radiograph by Dr. George C. Johnston showing diverticulum in a woman aged 58 years. Diverticulum removed by the Gaub-Jackson method (Case 1).

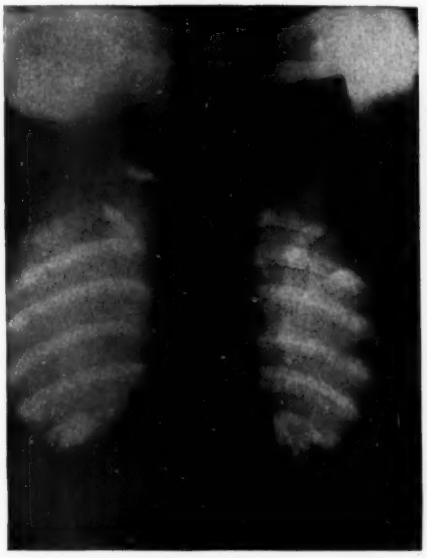

Fig. 7. Radiograph showing a diverticulum in a man of 67 years. Diverticulum removed by the Gaub-Jackson method. (Plate made by Dr. H. K. Pancoast.)

removal is shown in Fig. 5. There was leakage through the neck wound in this case, but healing was complete and swallowing perfect in about four weeks. Almost a year has elapsed and the patient's swallowing is still perfectly normal. Fluoroscopic examination by Dr. George C. Johnston showed that the bismuth mixture went through the region formerly occupied by the diverticulum without hesitation.

Remarks. This patient was regarded by Dr. J. H. McKelvey before operation as an unfavorable surgical subject because of feebleness, advanced age, impaired vessels, and chronic purulent bronchitis. These conditions fully accounted for a more tardy convalescence than in the first case. This case demonstrated forcibly the great advantages of the expedition afforded by the technical improvement herein advocated. Had the tedious classical operation been done it is questionable if the feeble, senile patient would have survived.

CONCLUSIONS

1. If untreated, pulsion diverticulum of the œsophagus tends strongly to increase in size and in severity of symptoms.

2. Intratracheal insufflation anæsthesia affords advantages in (1) removing the anæsthetist far from the operator's way; (2) avoiding infective risks; (3) insuring safety of respiration and a quiet peaceful anæsthesia in spite of tracheal pressure or glottic spasm from manipulation of the tissues during the surgeon's dissection and amputation.

CYSTS OF THE MESENTERY

With a Report of Three Cases[1]

By EDWARD G. JONES, A.B., M.D., F.A.C.S., Atlanta, Georgia
Professor of Surgery, Atlanta Medical College.

THE points of particular interest centering around cysts of the mesentery are their rarity, their genesis, their disputed classification, the infrequency with which they are diagnosed, and their rôle in causing intestinal obstruction.

Lawson Tait is said never to have seen a mesenteric cyst, and Spencer Wells[2] only two. Dr. L. L. McArthur,[3] of Chicago, stated in 1912 that he had never seen a chylous cyst of the mesentery, and quotes the late A. H. Ferguson as having had the same experience. In 1912, Friend,[4] of Chicago, collected 52 cases of the chylous type of these cysts; and in 1913 A. L. Benedict,[5] of Buffalo, supplemented Friend's list, bringing the total up to 96. The chylous type embraces approximately one-half of the mesenteric cysts reported, so that about 200 in all have now been recorded.

Information as to the origin of these cysts is based largely upon a study of the cyst-contents and of the cyst-wall, and classifications have been based upon these findings.

An effort to revise their classification in conformity with their origin, and to put them all, except hydatid and malignant cysts, under the head of embryonic growths, was made by Dowd[6] in 1900. He found in the mesentery of the transverse colon a cyst which corresponded with ovarian cystadenomata in the very material respect of containing pseudomucin and in the further fact that certain secondary cysts growing from its inner wall were lined with epithelial cells. He also found evidence of degenerated epithelium lining parts of the cyst-wall proper. Arguing from these findings he concluded that the cyst originated in a portion of the ovary or germinal epithelium, separated from the rest of the organ in the early process of development. He showed further that it was at least possible, and to his mind probable, that those cysts which had hitherto been classed as chylous, serous, sanguineous, and lymphatic were in reality all embryonic.

However, those changes in the cyst-contents which are developed by time, and particularly those changes in the cyst-wall which are induced by pressure, inflammation, etc., so tend to invalidate the evidence that at one time may have been present in the average mesenteric cyst as to render Dowd's theory at least incapable of anything like uniform proof. Not a few cysts have been found whose origin could be traced with reasonable certainty to a sequestration from the intestine, or from the ovary, or to relics of other structures like the omphalomesenteric duct.

The fact, however, that the usual mesenteric cyst is not lined with epithelium at the time of its examination must not be taken as evidence that such a lining did not exist during the early development of the cyst. The gradual or sudden accumulation of fluid within its cavity may have destroyed the epithelial structure; inflammation may have accomplished the same change. Such, indeed, we know is the history of parovarian cysts; that is, when small they are lined with epithelium, but as they increase in size this epithelium is at first modified and later destroyed.

R. T. Miller[7] reviews at length the theories as to the origin of mesenteric cysts, and records a most interesting case of such a cyst which indisputably represents an intestinal sequestration. He quotes the work of Lewis and Thyng, who in 1908 first observed the actual process of sequestration in the developing gut, and whose findings prove that mesenteric cysts undoubtedly may originate

[2] Douglas. Surgical Diseases of the Abdomen, p. 731.
[3] Surg., Gynec. & Obst., 1912, xv, 1.
[4] Ibid.
[5] Surg., Gynec. & Obst., 1913, xvi, 606.
[6] Ann. Surg., Phila., xxxii.
[7] Bull. Johns Hopkins Hosp., 1913, xxiv, October.

[1] Read before the Southern Surgical and Gynecological Association, Asheville, North Carolina, December 1914.

Fig. 1. Resected portion of intestine with cyst, Case 1.

as intestinal diverticula. Furthermore, there is a very general belief that a certain additional number have their origin in the omphalomesenteric duct.

The following illustrates the progressive changes which have been made in the classification of mesenteric cysts since a large enough number have been studied to warrant classification: In 1897 Moynihan[1] classified them as—

1. Serous;
2. Chylous;
3. Hydatid;
4. Blood;
5. Dermoid;
6. Cystic malignant disease.

Only the dermoids suggest an embryonic origin. In 1900 Dowd[2] proposed—

1. Embryonic;
2. Hydatid;
3. Cystic malignant disease.

Here the embryonic origin of nearly all these cysts is implied. In 1907 Niosi subdivided the embryonic cysts as follows:

1. Cysts of intestinal origin:
   (*a*) By sequestration from the bowel during development;
   (*b*) From Meckel's diverticulum.
2. Dermoids.
3. Cysts arising from retroperitoneal organs (germinal epithelium, ovary, wolffian body, müllerian duct).

So that whether or not one agrees with the view that most mesenteric cysts are embryonic, there is evident a growing tendency to believe that a great many do so originate.

It should be said that mesenteric cysts have been variously supposed to originate

[1] Ann. Surg., Phila., xxvi, 1.
[2] Ann. Surg., Phila., xxxii.

Fig. 2. Showing mesenteric cyst found in hernial sac, Case 2.

from dilated or ruptured lymph-vessels, from degenerating lymph-glands, and from the receptaculum chyli; and such sources can at least not be disproved. There are those (Braquehaye, Moynihan, Porter, and others) who do not at all agree that practically all mesenteric cysts are embryonic and who adhere to those classifications of which Moynihan's is a type.

It is to be regretted that in the cases outlined below there appeared findings of no particular significance as bearing on the subject of genesis. Sections taken from various parts of the cyst-walls failed to reveal epithelial lining or other suggestive structure.

It is probable that a diagnosis of a mesenteric cyst is seldom, if ever, made prior to operation or autopsy. It would seem, however, that the time has come when such a diagnosis ought to be made in typical instances with reasonable certainty — largely because during the last decade enough cases have found their way into the literature that the surgeon will at least be cognizant of the fact that such a tumor may be in the abdomen and that it should not be overlooked.

Of course, a diagnosis presumes that the cyst has reached some size. If its location be in the mesentery of the small intestine (and not confined to the root of the mesentery) the outstanding feature will be its extreme

Fig. 3. Showing colon at hepatic flexure with cysts in mesentery, Case 3.

mobility. Theoretically, and sometimes actually, it can be carried from one side of the abdomen to the other, and can be made to perform similar excursions in a vertical direction. The tumor may at times be rotated on its own axis. Given such a movable tumor, centrally situated, fluctuating, surrounded by resonance, not connected with the ovary, liver, kidney, or spleen, and the diagnosis is practically certain. If there can be added to this information a band of resonance crossing the tumor and a history of recurring attacks of pain and vomiting a positive diagnosis is warranted.

Porter[1] says cysts of the mesentery more often cause pain than do any other cystic abdominal tumors, and adds that the same is true of vomiting. These symptoms depend usually upon the encroachment of the cyst upon the lumen of the gut. If the encroachment be moderate, colicky pains due to exaggerated peristalsis proximal to the tumor are apt to occur; if the encroachment be more marked actual obstruction to the fæcal current may ensue.

[1] Ann. Surg., Phila., xliii.

Of prime surgical interest is the possibility of acute intestinal obstruction. Among the types of obstruction, volvulus is prominent. It is possible that in Case 1, reported below, recurring attacks of volvulus had covered three years. In a number of reported cases such recurring attacks were probable, so that such a history assumes considerable diagnostic significance. Porter quotes von Blum as having first called attention to this fact. In Porter's case, acute obstruction occurred from strangulation over a band formed by the cyst pedicle. Further, the stretching of the gut over the cyst has amounted to gangrene (Sutherland). Besides the above types of obstruction there are the usual possibilities of such an accident resulting from adhesive bands between the cyst and neighboring viscera, or following peritonitis (and its consequences) from rupture of the cyst.

These cysts have been treated by aspiration, by stitching to the abdominal wall and draining later, by enucleation, and by resection of the affected portion of the gut.

Aspiration is no longer justifiable unless indeed it be practiced as a preliminary procedure or for temporary relief when more radical measures would be unsafe. Drainage is not ideal surgery, though published statistics indicate that it is not only safer than resection, but that it more frequently cures the patient than one would suppose. These statistics do not, however, probably represent the relative wisdom of drainage and resection at the present day. Being a simple procedure it is natural that the immediate mortality should be relatively low, but the percentage of patients who are not finally cured must enter into a consideration of the comparative merits of drainage and other more ideal measures. Of course, when the condition of the patient is critical the simpler procedure is the wiser. In my own Case 1 drainage would probably have been wiser except for the volvulus.

Enucleation is the ideal treatment if it can be done safely.

Resection is, next to enucleation, the treatment of choice unless conditions call for the quickest possible operation.

CASE 1. Patient, male; age 4; referred by Drs. Bell and Tribble, Lithonia, Georgia. Family history: Negative. Past history: When six or seven months old he had convulsions with some sort of acute abdominal trouble. Convulsions lasted three to six hours, after which the patient gradually recovered from his abdominal symptoms, which were present several days. Every one to six months since the above attack the child has had somewhat similar abdominal seizures, but without convulsions. He always complained of his "stomach hurting," and always vomited. These attacks always came on suddenly, and the severity lasted only one or two hours. Parents do not recall that there was any difficulty about the bowels moving, although they think the abdomen was usually distended during attacks. At the age of two or three years the boy is said to have had typhoid and was in bed one month. This sickness began with vomiting, and throughout the month there was diarrhœa. Since the typhoid, the acute abdominal seizures have continued as before. Parents have noticed for two years that the child's abdomen was unusually full above the umbilicus. They cannot recall that the acute attacks commonly followed a jump or fall. Vomiting and purgation have relieved the situation prior to the present attack.

Present illness: Four days prior to operation the patient, after jumping from a wagon, was almost immediately seized with abdominal pain and vomiting. This time the pain and vomiting continued, and the family physician, on being called, administered purgatives and enemas without being able to get a bowel movement. These efforts were continued three days when we saw the child. The vomiting had continued meantime without abatement. Physical examination: The child was fairly well nourished. Distention was moderate. The temperature was normal, the pulse 120. On account of the constant crying of the child no very satisfactory physical examination could be made. Visible peristalsis in the upper abdomen was marked. Rectal examination was negative. Diagnosis: The symptoms were those of obstruction without actual strangulation, and a diagnosis of probable intussusception was made.

Operation: The abdomen was opened promptly through the right rectus. Immediately there came into view a yellowish mass in the mesentery of the small intestine (Fig. 1). The cyst had encroached on the gut so as to greatly restrict its caliber; the intestine indeed being stretched over the cyst like a ribbon and partly buried in it. The whole mass had so fallen over as to twist the gut above into a volvulus. There were no adhesions. The greatest diameter of the cyst (longitudinal axis of the intestine) was perhaps 16 cm., and its transverse diameter about 8 cm.

The cyst encroached so closely upon the gut for such a distance that enucleation was unwise; the integrity of the intestine at the point of volvulus was furthermore doubtful. Resection of the gut together with the cyst was done. The location was in the mesentery of the ileum, some four feet from the ileocolic junction.

At the close of the operation the child's condition was fair. He reacted indifferently. Within 18 hours he began to have convulsions, his temperature and pulse rose, and he died 30 hours after operation, his bowels meantime having moved two or three times.

Autopsy showed no evidence of leakage around the button and no peritonitis.

Laboratory examination by Dr. John Funke: Specimen: Cyst from the mesentery. It consists of an irregular globular mass being largely, from the external appearance, divided into two unequal parts, the larger measuring 10 by 6 cm. and the smaller 6 by 4 cm. The external surface of the mass is quite smooth and glistening. On this surface are many small tortuous blood-vessels.

Part of the structure which seems to tend to divide the mass appears to be a tubelike structure resembling a portion of the intestine, while the rest is a bandlike structure composed of two membranes with an intervening loosely woven tissue.

On opening, the mass revealed eight pouches, all of which communicated. With but two exceptions the communications are large and wide, so that one cannot state whether the whole mass is the result of a confluence of eight smaller cysts or whether these cavities are the result of a bulging of the wall of the original cyst.

The lining of these cysts is smooth and glistening.

The mass contained 300 ccm. (an equal amount had previously been evacuated) of grayish yellow fluid, the chemical examination of which is as follows: Reaction, neutral; albumin, abundant; mucus, none; pseudomucin, none; sugar, none; urea, 0.3 per cent; specific gravity, 1,012; NaCl, trace; neutral fat, small quantity.

Microscopical examination (fluid): Cholesterin crystals, many; erythrocytes, many; a granular, apparently cellular, body the nature of which could not be determined.

For microscopical purposes parts of the cyst-wall were taken from various places.

Histology: The cyst-wall is composed of three parts, one being very distinct and is composed of fibrous tissue and has the appearance of a basement membrane, but at no point can epithelium be seen, nor is there any evidence which would lead one to believe that epithelium had ever been present. One is not able to state that such cells might have been present at one time. Of the other two parts differentiation is difficult, one blending into the other. The middle part is mostly composed of muscle and elastic tissue, in which there are a few round rather deeply staining cells not at all unlike connective-tissue cells. The third part is principally composed of fibrous tissue. Those portions of the cyst-wall taken near the mesentery contain, among the adipose tissue adjacent to the wall, one lymph-gland which is normal in every respect.

Remarks: Gross and microscopic study divulges nothing as to the origin of the cyst. There is no proof by means of which one can rule out an omphalomesenteric cyst any more than there is present anything which would prove it to be such a structure. There is nothing by means of which one could say that the cyst is the result of a dilated lacteal, nor is there any proof of an enterogenous origin. The small quantity of fat present would tend to make one rule out the dilatation of a lacteal.

CASE 2. Male, age 54; Grady Hospital service. This patient had had a left-sided oblique inguinal hernia for 15 years, and a similar hernia on the right side for 6 years. Both had been progressively increasing in size. He had worn a truss intermittently. For two years prior to coming to us he had been unable to reduce the left-sided hernia.

Patient entered hospital for hernia operation. Upon examination there was found as a part of the contents of the left hernial sac a painless globular mass not connected with the testicle, apparently containing fluid. It was too large to be returned through the hernial opening. No diagnosis as to its character was made.

At operation the mass proved to be a cyst of the mesentery (Fig. 2). It approached to within one inch of the intestine. It was enucleated without difficulty. Its wall was rather thick. Its greatest diameter was about 3½ inches. No effort was made to determine what part of the small intestine was involved. The patient recovered promptly.

Remarks: Moynihan refers to a patient of Morton's in whom the irreducibility of an inguinal hernia was due to a blood-cyst. So far as I am able to discover, no other mesenteric cyst has been found in a hernial sac.

There is no way to determine whether this cyst originated before or after the descent of the mesentery into the scrotum. If it originated before such descent it had increased in size since it passed through the inguinal canal, since it was too large to be returned into the abdomen.

Laboratory examination by Dr. A. H. Bunce: This specimen of tissue consists of portions of a cyst-wall. A part of the outer surface is covered by peritoneum; the remainder shows many adhesions of fibrous tissue. The inner surface is rough and irregular; the thickness of the wall varies from 1 to 5 cm.

Histologic sections through the wall show that it is made up entirely of fibrous connective tissue. There are only a few blood-vessels present, and these have very thin walls. Much round-cell infiltration is present, and in some areas there is considerable hyaline degeneration. No definite layer of lining cells is present. Hence the histologic examination sheds no light on the origin of the cyst.

The fluid is clear, straw-colored, and has a specific gravity of 1,022. Its reaction is alkaline. No reducing substance is present. Proteids are 4.7 per cent; fats approximately .74 per cent. A trace of cholesterin is present.

Microscopically there are many lymphocytes, a few red blood-cells, and much detritus.

The fluid is sterile.

CASE 3. Male, age 32, referred by Dr. C. M. Walker, Westminster, S. C. Patient presented himself for severe attacks of abdominal pain in the upper right quadrant recurring every one to three months, and covering three years. These seizures were accompanied by vomiting and distention. There was always difficulty in getting the bowels to move. His digestion had been bad for a year. He had lost 15 to 20 pounds in weight. The attacks came on and disappeared suddenly, and were not accompanied by fever or chills. His symptoms were always distinctly abdominal. The patient was not jaundiced, and had not been previously.

The patient was seen some three days after an attack. He had tenderness and an ill-defined immovable mass in the right upper quadrant. The urinary findings were negative. The patient was supposed to have gall-stones with complications of a subacute inflammatory nature.

At operation there were disclosed three cysts lying in the mesentery of the colon at the hepatic flexure (Fig. 3). The outer one of these pushed down behind the terminal ascending colon for a short distance; the others were in the mesentery of the transverse colon reaching nearly to the midline. They were crowded closely upon each other, and the colon was quite taut over the mass, which had, roughly speaking, a diameter of six inches, though irregular in shape. They were enucleated by incising the outer layer of the mesocolon at the hepatic flexure and working thus inward. The first portion of the duodenum was lifted by the mass as it lay *in situ;* the third portion evidently suffered by being pressed backward against abdominal wall.

The patient has gained 20 pounds and remains well two years after operation.

These cysts were thin-walled and contained clear straw-colored fluid. Through an inadvertence the specimen was thrown away so that no careful examination was made.

The loss of this specimen was quite unfortunate, particularly because I found lying against the inner wall of the cyst nearest the midline a nodule three-fourths inch in diameter which was opened during the operation and which I was sure contained oily matter and hair. The lack of later and more deliberate opportunity to study the specimen, however, prevented such verification of the dermoid character of the nodule as would justify an unequivocal statement that it was such. Dermoids of the mesentery, especially in the male, are so extremely rare that one hesitates to so classify this cyst without indisputable evidence.

THE TREATMENT OF ANGIOMATA BY THE INJECTION OF BOILING WATER (WYETH METHOD)[1]

By FRANCIS REDER, M.D., F.A.C.S., Saint Louis

IT may prove of interest to preface my remarks on the treatment of angiomata with a short résumé, setting forth some of the characteristics of these vascular tumors. In speaking of a blood angioma we designate a tumor composed of dilated and abnormally arranged blood-vessels in thin trabeculæ of connective tissue. These tumors present such clearly defined pathological features that they may be conveniently divided into the superficial or simple and the deep or cavernous.

The simple angiomata, the so-called port-wine stains and mother's-marks, usually occupy the superficial layers of the cutis. They may, however, be harbored in the subcutaneous or submucous tissue and assume the form of fairly large swellings.

In their construction they consist of tortuous and dilated capillary vessels, embedded in a small quantity of connective and adipose tissue. It is not unusual to find the involved area of skin slightly elevated. If these newly formed vessels are very abundant, if there is a marked thinning of the epidermis and a flattening of the papillary bodies, the condition will be designated as a cavernous nævus.

The discoloration of the simple angioma, which imparts to it one of its chief characteristics, depends upon the depth of the affected vessels. If they are superficial, the markings usually appear red; and when subcutaneous, a purplish or bluish color is imparted. The color of a simple angioma can be made to disappear by pressure, temporarily restoring to the skin almost its normal whiteness, but as soon as the pressure is relieved the discoloration returns.

These angiomata possess no clinical significance. Exclusive of the unsightly appearance of some, they cause no discomfort, and it is not often that the possessor of a port-wine stain seeks advice as to the possibility of having it removed. Even so, should the angioma involve a large area, which they not infrequently do, nothing of an encouraging nature as to its total or even partial removal can be promised.

An interesting fact in connection with capillary angioma is that their distribution quite often corresponds to the area of distribution of the three branches of the fifth cranial nerve; viz., angiomata of the frontal germinal area, angiomata of the superior maxillary area, and angiomata of the inferior maxillary.

Bärensprung was the first to call attention to this, and his observations were later confirmed by Cushing and others.

Simon entertained a similar theory. He became impressed with the idea that nutritive disturbance in the region of the trigeminus was causal in producing such a condition.

Lamy also, in his interesting exposition of this lesion, adheres to a theory that angiomata are congenital vascular productions caused by modifications occurring during embryonal development.

Virchow advanced a theory that angiomata find their origin in the embryonic relations when slight irritative conditions about the margins and the circumference of the fœtal clefts, which are always copiously supplied with blood-vessels, may cause an abnormal development about these parts, with the possibility of a nævus formation. Such a condition may remain latent for a time, and later manifest itself as a cavernous angioma.

All-glass syringe, small size, for injecting boiling water into an angioma. Note the asbestos plunger, the large ring at the end of the piston, the shoulder of the barrel, and the point of the barrel ground to receive the "slip" needle.

[1] Read before the Southern Surgical and Gynecological Association, Asheville, North Carolina, December 15–17, 1914.

Baby C. Baby E. Baby G.

Baby C., age 2 years. Angioma of lower lip in left corner of mouth. When baby laughed this tumor would roll out of corner of mouth and appear as large as a California grape, dark purple in color. Three injections obliterated the tumor. First injection, April 6, 1914, 0.5 ounces. Second injection, June 3, 1914, 0.5 ounces. Third injection, October 11, 1914, 0.5 ounces.

Baby E., age 3 years. Angioma involving left upper eyelid. This tumor grew rapidly during the last four months and interfered with vision. Two injections obliterated angioma. First injection, January 3, 1912, 2 ounces. Second injection, March 1, 1912, 1 ounce. Disappearance of tumor by July 1, 1912.

Baby G., age 18 months. Angioma of right cheek, complicated with a nævus. Four injections obliterated the angioma. First injection, September 10, 1913, 3 ounces. Second injection, October 12, 1913, 3 ounces. Third injection, December 6, 1913, 2 ounces. Fourth injection, February 18, 1914, 2 ounces. The tumor had entirely disappeared by June 1, 1914. The nævus was destroyed with two applications of von Paquelin's cautery.

Peter E. Albert H. Baby M.

Peter E., age 19 years. Angioma on tip of nose and underneath upper lip. Two injections required for tumor underneath the upper lip, and three injections for angioma on tip of nose. Owing to the cartilaginous structure of the tip of the nose, much difficulty was experienced in making these injections. First injection, June 2, 1911; nose, 0.5 ounces, lip, 2 ounces. Second injection, July 8, 1911; nose 0.5 ounces, lip, 1 ounce. Third injection, September 2, 1911; nose, 0.5 ounce. Complete disappearance by October 1, 1911.

Albert H., age 42 years. Angioma of tongue. Two injections obliterated the angioma. First injection, May 8, 1913, 2 ounces. Second injection, June 22, 1913, 1 ounce. Disappearance of tumor by September 1, 1913.

Baby M., age 7 months. Angioma of lower lip. One injection of boiling water obliterated the angioma. The angioma was injected with 1.5 ounces January 5, 1914. There was complete disappearance of tumor by April 1, 1914.

Mr. F., age 32 years. Angioma behind right ear extending well down on neck. This patient had been subjected to a surgical measure with almost fatal result. Two injections were sufficient to cause obliteration of the angioma. First injection, March 14, 1909, 6 ounces. Second injection, April 18, 1909, four ounces. Tumor mass practically disappeared by June 1, 1909.

Mr. F. Appearance of patient June 1, 1909.

He has applied to them the name of "angioma-fissuraux."

According to Ribbert, the genesis of angiomata rests with two questions: Is the tumor a simple dilatation of the vessels in a circumscribed area? Or is the tumor the result of a new-growth? To this may be added Stangl's argument as to whether or not these tumors are of epithelial or connective-tissue extraction. Ribbert advocates the view that these vascular tumors are the result of a new-growth. It is true that their histological formation closely resembles certain types of malignancy, yet, clinically, angiomata are considered non-malignant. That angiomata are congenital in their origin is no longer a disputed fact.

Cavernous angiomata, the type of vascular neoplasms in which the interest of this paper is centered, present a pathology that microscopically does not differ from the simple angioma. It is only macroscopically that its characteristics overshadow the latter.

A practical definition for a cavernous angioma would be that it is a soft, non-pulsating swelling, of variable size, with a thin covering of skin, usually bluish in color. Its great differential factor is that the entire tumor can be caused to disappear upon pressure, with a prompt return to its original size as soon as the pressure is removed.

These vascular neoplasms present individual characteristics. Particularly is this true when some of the vessels entering into the formation of the tumor empty arterial blood in sufficient quantity into the spaces to cause a distinct pulsation.

Furthermore, the connective tissue enmeshing the vessels is sometimes scanty and sometimes plentiful, thus causing irregularities in the circulatory apparatus of the angioma with a resultant lobulated appearance of the tumor.

An additional individual characteristic of import is that a cavernous angioma is responsive to the temperament of the possessor; excitable influences causing the tumor to swell, become tense, and more deeply discolored.

The construction of a venous angioma

Baby K.

Baby K., 18 months old. Angioma in left frontoparietal region. Two injections obliterated the angioma. First injection, May 2, 1914, about 2.5 ounces. Second injection, May 28, 1914, about 1.5 ounces. Disappearance of tumor by August 1, 1914.

John F.

John F., age 32 years. Angioma of right middle finger near knuckle. One injection of 2 ounces caused tumor to disappear in six weeks.

Frank L.

Frank L., age 40 years. Angioma of left gluteal region. Five injections required to obliterate this tumor. First injection, February 4, 1910, about 5 ounces. Second injection, March 6, 1910, about 5 ounces. Third injection, May 2, 1910, about 3 ounces. Fourth injection, June 18, 1910, about 3 ounces. Fifth injection, August 2, 1910, about 2 ounces. Complete disappearance of tumor by November 1, 1910.

consists of irregular fibrous alveoli which communicate freely with one another. The

Miss S., age 24 years. Angioma of left cheek and upper lip. Ligation method with loops of silk tried and failed. Five injections of boiling water and one injection of alcohol obliterated the tumor mass. First injection, June 25, 1906, 4 ounces. Second injection, August 2, 1906, 3 ounces. Third injection, August 18, 1906, 2 ounces. Fourth injection, August 30, 1906, 1 ounce. Fifth injection, September 25, 1906, 1 ounce. Sixth injection, October 8, 1906, 1 ounce alcohol. Alcohol was substituted for boiling water on account of fear of too great a contraction with a possible deformity about the lip. Appearance of patient December 1, 1906. A slight scarring of upper lip occurred, the result of a superficial slough. The scar was excised a year later.

theory that these neoplasms are caused by a dilatation of the capillaries, the walls of which eventually become absorbed, resulting in the formation of spaces, has been favorably received. The walls of these spaces possess an endothelial lining similar to that of veins. These cavities are distended with blood, supplied by numerous tortuous vessels, which circulates with varying degrees of rapidity. The arteries open directly into the cavities.

Venous angiomata may be diffuse or may form distinctly circumscribed tumors. The circumscribed cavernous angioma possesses its distinct efferent artery and afferent veins and does not communicate with the neighboring capillaries; i.e., there exists no anastomosis with the capillaries in the surrounding tissue. The angioma shows a circulation wholly within itself, with only a connection with the arteries and veins of the neighborhood.

Their growth is slow. They increase, however, progressively in size with the growth of the patient. For instance, a babe which at three months shows an angioma upon its lip that has the appearance of a flea-bite will exhibit the same lesion the size of a hazelnut nine months later.

From statistics it must be inferred that

the face is the favored locality for these neoplasms, two-thirds of these growths being located there. The brow and the cheek seem to be favored regions. Next in frequency come the lips, the nose, the ears, and the eyelids. Strange as it may appear, the feminine sex is more prone to this affliction than the male, two-thirds of all cases occurring in females. Cavernous angiomata may occur also in the orbit, muscle, liver, spleen, kidneys, and stomach (Sherrill).

Inasmuch as there is no pain in connection with such a vascular tumor, except when the swelling causes pressure upon a nerve, the discomfort experienced must be ascribed to its size and location; for instance, a vascular tumor situated upon the upper eyelid can become very annoying on account of visual interference. Again, an angioma of the cheek may involve the buccal tissue to such an extent as to make mastication difficult and even dangerous. This was exemplified in one of my cases where the patient accidentally bit the inner side of her cheek, causing an alarming hæmorrhage.

Is a cavernous angioma a lesion that endangers life? The reply to such a question must be guarded. These vascular tumors possess an element of danger in proportion to their size and location. When there is non-interference their growth may eventually produce a secondary lesion by spreading indefinitely, which may cause death. The greatest danger rests with an operative intervention for their cure, and the danger is hæmorrhage. Many of these vascular tumors are inoperable, as has been demonstrated repeatedly by an attempted operative measure which had to be abandoned.

That the prognosis is discouraging in the extreme is evidenced by patients who for years have endured the deformity and the discomfort simply because nothing could be done for them except the suggestion of a hazardous surgical operation.

When Dr. Wyeth advocated the injection of boiling water into these tumors as a curative agent, I doubt very much if he was aware of the greatness of his beneficent advice. In a series of some twenty-six cases, which have been subjected to this treatment, I have no failures to record. In every instance the results have been very gratifying. I may state that most of these cases presented the lesion upon the face and scalp. Four patients presented angiomata upon the tongue, ranging from the size of a filbert to that of an English walnut. One patient presented the lesion upon the left gluteal region, as large as a cocoanut, and another patient, a young man of eighteen years, presented a fusiform angiomatous growth upon the right middle finger, between the second phalangeal articulation and the knuckle.

The surgeon who is confronted with a cavernous angioma must appreciate the gravity of this affliction. He will realize in a comparatively short time that these neoplasms are among the most difficult lesions he may meet with. All forms of operative intervention in these vascular tumors harbor the great danger of hæmorrhage. In most instances this is alarming and exceedingly difficult to check.

The operation for the starvation of inoperable tumors by dissection and ligation of all branches of arteries distributed to the regions involved (Dawbarn) is not readily applicable to this type of tumor. The strangulation method also has proved ineffective, and the attempt at chemic decomposition with electricity or cauterization by means of a heated wire has given results that have only been partially efficient. The injection of alcohol and preparations of iron have proved disappointing.

It remained for Dr. Wyeth to demonstrate that water at a high temperature injected into the neoplasm was a safe and curative agent, that through this agent the blood and albuminoids are coagulated, the resulting diminution and eventual disappearance of the tumor resulting through obliteration by granular metamorphosis.

Dr. Wyeth's procedure is a simple one. It is astonishing how little pain is experienced after the injection, which is done under ether or nitrous oxide anæsthesia. Small children commence to play soon after the effects of the anæsthesia have passed off, disregarding the increased swelling caused by the boiling-water injection.

Are there any dangers connected with the injection of boiling water into these neoplasms? The reply must be promptly given in the affirmative.

An injudicious use of boiling water may result in the sloughing of tissues, with a resultant infection. After an arduous delay cicatrization will take place, adding an additional defect to the already existing one. I may state here that it is not a simple matter to judge a boiling-water injection properly. If the angioma is in the neighborhood of the eye, the injection must be given with the greatest care, lest an injury to that organ should result. Another matter, and one of vital import, is the danger of embolism. To preclude as far as possible such a danger, peripheral compression while the injection is being made becomes imperative. These are possibilities that must be reckoned with. They weigh heavily upon the mind of the surgeon who deals with boiling water and a cavernous angioma.

In making the injection certain conveniences will expedite this measure. A suitable syringe is essential. I have found an all-glass syringe with a good shoulder, a large ring on the piston, and an asbestos plunger answers the purpose better than any of the many I have tried. A syringe with an all-glass plunger has its drawbacks, inasmuch as the steam generated within the barrel will find its way between it and the glass plunger, thus inhibiting the free and easy movement of the piston so essential to this procedure.

The slip needle (small caliber) is the preferable one. With it no time is lost in the transference of the boiling water. It should always be borne in mind that the water must be injected as near the boiling temperature as is possible, and time is an important factor.

A pair of easy-fitting chamoisette gloves of good thickness have served me well. That portion of the glove intended for the little finger is cut off, so that the degree of heat in the tissues can be judged by occasional contact with the little finger.

The arrangement in the operating room should be such that the surgeon stands between the vessel containing the boiling water — this vessel being kept constantly at the boiling point over a flame — and the patient, at a distance that will not necessitate a step on the part of the surgeon for the transference of the boiling water into the tumorous mass.

The parts not involved in the tumor should be protected with moist cloths, lest a scalding of these tissues result from the hot water in the syringe being forced out by the generated steam.

The introduction of the needle and the force applied in injecting the hot water are of great importance. Inasmuch as the weak tissues of the new-growth do not offer the resistance of normal skin, which overlies the angioma, the hot water injected without great care may cause these tissues to break down. Injections made directly into the enlarged capillaries are invariably followed by a necrosis. For this reason it is well to make the initial injections through the sound skin about one-sixteenth and one-eighth inch from the edge of the angioma, well beneath the neoplasm, thus assuring coagulation of the deeper parent vessels. This is also a wise precaution against the dangers of embolism.

If the arteries leading into the tumor can be demonstrated, it is well to enter the needle along their course and inject a sufficient amount of boiling water to cause coagulation in these vessels.

Judgment should be exercised, in introducing the needle, to prevent the point from resting too near the opposite wall of the tumor. To estimate this procedure properly it is well first to introduce the needle without the syringe, pushing it through the mass till it can be felt on the opposite side, then withdrawing it to the extent of a half-inch. This will give a reasonable assurance that the boiling water can be injected into the tumor without the probability of sloughing. When the skin begins to turn grayish in color the injection into that area is to be discontinued. Hyperdistention must be carefully guarded against. The amount of hot water necessary to cause this bleaching rests wholly with the amount of tissue under treatment. After coagulation of this particular area has been satisfactorily accomplished, the point of the needle is made to penetrate into an-

other area and the hot water injected. In this manner the needle is introduced into the tumor in different places, always from side to side, and at various angles, until the whole mass gives evidence of coagulation.

The quantity of hot water which may be injected at one sitting can be as much as three or four ounces in a tumor the size of a hen's egg, the time consumed in making the injection being about ten minutes. However, if the new-growth is of unusual size, it would be advisable to inject only a portion of the tumor at one time, making a subsequent injection two or three weeks later.

Angiomata under treatment with hot water must be scrutinized closely and the areas that have not been affected must be dealt with. In this manner a tumor the size of an orange may require two to four injections, the period of time for a cure being two to five months.

It is interesting to observe the characteristics presented by an angioma subjected to the hot-water treatment. The independence of the blood spaces from the blood-vessels of the surrounding tissue can be demonstrated by the fact that the neighboring tissue is not affected; i.e., none of the hot water finds its way into the adjacent structures while the injection is being made. However, shortly after the injection an œdema of the immediate parts begins to manifest itself. This œdema may be very extensive, according to the amount of hot water injected. Frequently, when the lesion is on the face, the swelling may become so extensive as to close the eyes. Although the condition looks alarming, there is little ground for actual fear. The patient suffers no pain, the condition is an afebrile one, and the œdema usually subsides within the first week. It is a wise precaution to apply ice or very cold compresses to the tumor and surrounding tissues immediately after the injection for the first four to six hours, thereby lessening the severity of the œdema.

At the end of the first week the tumor, but slightly diminished, has almost fully lost its pathological color, and the tissues are beginning to assume a normal appearance. To the touch the mass is hard. If it remains hard the degenerative process is active and no further injection will be necessary. Should the tumor, however, begin to show evidence of softening, with visible formation of new blood-vessels, an immediate injection is indicated.

The course of an angioma successfully injected is one of gradual diminution, the greatest progress being made from the second to the third week. A tumor the size of a hen's egg will usually require six to eight weeks for its disappearance. If the injection has been a fortunate one, i.e., free from any accident, such as cicatrization following sloughing, the site that once harbored the angioma will appear healthy and quite normal.

To illustrate the gratifying results of this hot-water injection, the history of two cases will be found interesting.

CASE 1. Miss S., age 22, always in good health, splendid physical proportions and excellent physical condition, inclined to suffer from periods of marked depression. Since childhood had a small bluish spot on her upper lip and immediately below left eye upon malar prominence. Seven years ago the bluish spot on the lip began to enlarge. It continued to grow very gradually and was the size of a tangerine when she presented herself to me June 6, 1906.

This was the condition of her face: The right side, excepting two-thirds of the portion of the upper lip, was normal. The left side showed a marked swelling of the cheek which pushed up the lower eyelid and encroached upon the left ala of the nose. About the malar prominence was an elevated bluish spot as large as a pea. The left nostril was considerably flattened, about one-half normal. Two-thirds of the cheek showed involvement in a tumor mass that hung down over the under lip within one-quarter inch of the margin of the lower jaw. The tumorous mass was of a dark-blue discoloration and was convoluted. Upon stooping, this mass would increase in size very perceptibly. The swelling was soft, the skin covering it appearing very thin to the touch. Upon pressure it could readily be made smaller by forcing the blood out of it. The evidence that there were cavities filled with fluid was unmistakable to the touch. The protrusion of the tumor was such that it was on a level with a line drawn from the tip of the nose across the cheek and down to the chin. The lower lip and the chin showed atrophic changes corresponding to the shape and contour of the tumor, caused by pressure of the overhanging mass. The incisor and canine teeth of the upper jaw had long been destroyed by the constant attrition of the tumor. Within the mouth there could be seen large bluish masses of mucous membrane lying between the molar teeth and filling about one-third of the cavity of the mouth, causing an impediment of speech. Fear of biting this mass

during mastication and causing free bleeding was a constant source of danger. It was a great discomfort to the patient because of the difficulty in eating. The patient carried the tumor in a sling partly because it relieved the weight and partly because it hid from view the unsightly mass.

Having had no previous experience with the hot-water injection, I spoke very discouragingly to her because I did not know how much good or how much harm I might be able to do her should I undertake to interest myself in her behalf. She had consulted a number of physicians, good and bad, during the past six years, seeking relief, but invariably returned home downhearted and discouraged.

The idea that occurred to me at first was to reduce the pendulous part of the tumor with the procedure that incurred the least amount of risk. I thought this to be the ligation method — strangulation by introducing loops of silk subcutaneously along the mucocutaneous margin of the lip. With a very small cambric needle I ligated the lower third of the tumor. Small as the punctures were, the bleeding was most obstinate, continuing for sixteen hours. With the aid of ice and pressure it was checked. The experiment demonstrated that it was not the procedure to be followed. The threads became infected and were removed on the fifth day. After nine days the infection had subsided. The condition remained the same, excepting that about one-half inch of the lip on the right of the median line had contracted; furthermore, hard nodules could be felt throughout the portion that had been ligated.

The condition as it presented itself after two weeks gave me considerable encouragement, and I concluded to resort to the treatment of injecting boiling water. The risks seemed to increase while I was debating with myself as to the advisability of using this method, and I spoke very frankly to the patient of what might happen. This case seemed to me to be one particularly prone to risks, inasmuch as so much mucous membrane had to be dealt with. To inject boiling water into spaces filled with blood seemed to me an operation not free from danger.

The first injection, under aseptic precautions, was made on June 25, 1906. Under ether narcosis, four ounces of boiling water were injected into the tumor. A small aspirating needle, three inches in length, was inserted into the swelling through healthy skin on the right cheek, about one-eighth of an inch distant from the tumor margin and about one-half inch below the nose. In making these injections, the advice of Dr. Wyeth was closely followed. All of the tumor was injected excepting the portion on the inside of the cheek. About fourteen minutes were required to inject the four ounces of boiling water. Time was lost by not having been able to obtain a Wyeth syringe. An ordinary glass syringe holding two ounces was used, the aspirating needle being attached to the syringe with rubber tubing. It was a clumsy way of doing this work, but it answered the purpose satisfactorily. The handling of boiling water is a rather delicate task.

While the injection was being made, the patient's face was protected in the immediate vicinity of the needle so that the boiling water which was being forced out at the needle junction by the confined steam would not scald the skin. The hands of the operator were protected by a folded towel. It did not serve the purpose well, and to those who have occasion to handle boiling water I would suggest the use of heavy duck gloves.

To anticipate as far as possible any danger from embolism, peripheral compression was applied. In introducing the needle, it was carried through the mass till the point could be distinctly felt through the skin. The withdrawing of the needle about one-half inch gave a reasonable amount of assurance that the boiling water could be forced gently into the diseased area without much danger of provoking any sloughing. The needle was introduced in four different places at various angles. In some places the integument turned pale, in others an ashen gray, while the water was being injected into the tumor. The heat of the water could be very distinctly felt through the tissues — they were hot.

After the operation the patient was put to bed. The following day the left side of the face was very much swollen, but not painful. The left eye was partially closed. A large blister had formed along the mucous border of the lip. The tumor felt hard to the touch. There was a slight rise in temperature (99.6°). Two days later the temperature returned to normal. The patient left the hospital on the fifth day. On July 26th a large scab that had formed on the lip margin was removed. The whole tumor was hard, excepting about two-thirds of the tumor mass inside of the cheek. Dimunition by granular metamorphosis had reduced the tumor to one-half its original size. I wish to state here that a linear sloughing of the skin occurred which extended from the ala of the left nostril to the margin of the lip. It resulted in a cicatrix that was but slightly disfiguring. This scar was removed subsequently.

On August 2nd, under ether anæsthesia, the buccal mucous membrane was injected with three ounces of boiling water. The outcome was most favorable, only a small slough resulting.

On August 18th, under ether anæsthesia, two ounces of hot water were injected into the lip. Some difficulty was encountered in introducing the needle on account of the hardened condition of the tissues.

On August 30th, without anæsthesia, one ounce of boiling water was injected into the buccal mass.

On September 15th conditions began to take on a normal appearance.

On September 25th, without anæsthesia, one ounce of boiling water was injected into the outer portion of the lip, which still appeared quite large. Ten days later the lip was almost normal.

On October 8th an injection of one ounce of alcohol caused the lip to assume so near a normal condition that further intervention was deemed unnecessary and the patient was discharged.

In substituting alcohol for boiling water, I wish to state that I feared too much of a contraction might take place with the use of boiling water and cause a deformity of the lip. I felt assured that in using alcohol the contraction would be but very little.

CASE 2. Mr. F., age 32, carriage painter, never seriously sick, was referred to me by Dr. C., Quincy, Illinois.

As far back as fifteen years he had experienced attacks of dizziness. During the last two years he had been unable to follow his trade as carriage painter on account of the severity of these attacks. Has had a small swelling behind his ear as long as he could remember. Four years ago the swelling had grown to such a size that it crowded his right ear forward and extended into his scalp and down upon his neck.

The condition of the tumorous mass when he consulted me, March, 1909, presented these characteristics: Extending from the mid-parietal region near the center of ossification on the right side down to the clavicular region, the tumor occupied the entire right half of the occipital region, crowding the right ear markedly forward. The contour of the tumor was clearly defined. The mass proper was elevated to a level with the helix of the ear. That portion of the tumor involving the neck was of a bluish discoloration. Upon palpation a distinct pulsation and a bruit were readily detected.

With the application of pressure the contents of the swelling could be forced out easily. Upon releasing the pressure the tumor promptly reappeared. With touch the roughened bone margins and many irregularities of the skull underlying the tumor could be distinctly discerned. This destruction of bone was caused by attrition of pulsating mass.

About the lower pole of the tumor were a number of cicatrices, the result of an attempted operation. The patient informed me that he almost perished from loss of blood when the operation was undertaken.

The condition of this patient was one of extreme distress. The ringing and noises in his right ear were incessant. He was unable to be on his feet on account of vertigo and was compelled to sleep in a sitting posture.

An attempt was made to administer an anæsthetic preparatory to the injection of boiling water. This, however, was found to be too hazardous a procedure, the influence upon the tumorous mass being such that it appeared as though it would burst.

The injection of hot water was made without an anæsthetic, and about six ounces were introduced. In making the injection, all factors of safety were considered: the scalp had been shaved and cleaned, and during the injection peripheral compression was diligently exercised.

In making the injection the needle was first introduced at the lower pole in the neighborhood of the vessels that led into the tumor. As soon as there was evidence of coagulation, following the injection, the needle was withdrawn and reinserted into the tumor at a different site. The needle was introduced about one-fourth inch from the mass. In this manner the whole of the tumor base was injected. After six ounces of hot water had been introduced into the mass it ceased to pulsate. While the injections were being given, cloths wrung out in ice water were frequently applied to the mass, which had become quite hot.

The condition of the patient following the first injection, exclusive of the enormous swelling that followed (the œdema involved the right side of the face, closing the right eye, and encroached upon the neck, throat, and chest), was very encouraging. He appeared more comfortable, the ringing in his ear had ceased, and he was able to lie in bed. At the end of four weeks the growth had diminished to less than half its size. The patient could sleep well and was able to walk about without experiencing dizziness. A second injection of about four ounces of hot water was given at that time. Six weeks later the tumorous mass had practically disappeared, excepting a small mass the size of a pigeon's egg at the angle of the mandible which had the appearance of an enlarged gland. An attempt was made to inject it, but the substance was found to be too resistant.

RÖNTGENTHERAPY IN NON-MALIGNANT DEEP-SEATED LESIONS[1]

By JAMES T. CASE, M.D., Battle Creek, Michigan
Röntgenologist and Assistant Surgeon, Battle Creek (Michigan) Sanitarium; Professor of Röntgenology, Northwestern University Medical School, Chicago; Attending Röntgenologist, St. Luke's Hospital, Chicago; Consulting Röntgenologist, Cook County Hospital, Chicago

THE application of röntgentherapy to skin lesions was the earliest therapeutic development of röntgenology. Later, the attention of the early investigators was directed toward securing effects in deeper structures, but owing to the imperfections in tubes, generating apparatus, and methods of technique, only desultory results were attained during the first decade of röntgenologic history.

Several recent technical developments, combined with special experimental and clinical studies of the last five years have given a new significance to the term "deep röntgentherapy." The writer refers first to the invention of the Coolidge tube, which has placed in the hands of röntgenologists a very powerful, but precise instrument, with the use of which it is possible to control the dosage with very great practical accuracy; second, the perfection of newer and more powerful sources of high tension current; and, third, the development of a technique involving filtered irradiation at short focus-skin distance through multiple skin areas.

My colleagues[2] on this evening's program were among the first to apply the methods which have come to be known as deep röntgentherapy. Williams, Boggs, Johnston, Hulst, Pancoast, Hickey, Crane, Lange, and Dachtler are some other Americans who have contributed materially to our knowledge of this subject, in which American physicians have kept well abreast of our European confréres.

Necessity for accurate dosage. The empiricism of early röntgentherapy persisted for a number of years, not for lack of effort to determine the physiological effects of the röntgen rays, but because of the impossibility of comparing the work of one man with that of another. Imperfections in apparatus made accuracy in X-ray dosage extremely difficult. Statements as to technique and dosage employed were so vague that much of the very exhaustive and painstaking experimental work of the older writers cannot be correlated with present-day researches concerning the effects of the rays. As a result, the present-day literature on röntgentherapy often shows a curious mixture of the old and the new—pouring new wine into old bottles, so to speak.

The record that in a certain experiment certain animals were treated fifteen minutes and other animals twenty minutes, or that one patient received two thousand minutes of treatment, or other similar incomplete statements with reference to the dosage, are very misleading. If one states that a certain number of X (Kienboeck) units or H (Holzknecht) units were administered to a given area, within a certain time, with or without a certain amount of filtration, such a record is perfectly comprehensible to all röntgen workers. In the absence of specific statements as to dosage in units, references to methods of treatment must include the following: Milliamperage, length of treatment, focus-skin distance, hardness of tube (either according to some standard penetrometer, or expressed as the equivalent spark gap), details as to the number of areas treated, amount and kind of filtration used, and the frequency of treatment. It is absolutely essential that published reports concerning röntgen irradiations include these technical details; otherwise, in the light of our present knowledge, such reports must be discredited.

The writer does not wish to leave the impression that all the questions relating to the accuracy of X-ray dosage are solved. The factors which govern the amount of irradiation reaching the deep-seated tissues are numerous and, in fact, not yet fully determined. But the introduction of certain new tubes which have come upon the market in the last year have made accurate measurements possible and it remains now for röntgen workers to

[2] Dr. Wm. Allen Pusey and Dr. G. E. Pfahler.

[1] Read before the joint meeting of the American Röntgen Ray Society (Western Section) and the Chicago Medical Society, March 3, 1915.

determine and formulate, out of clinical experience, the information still needed in this field. Now that it is possible to control the penetration of the tube with a satisfactory degree of accuracy, it is doubly important that estimates made by different observers under certain stated conditions be in very fair agreement.

Technical considerations. It is probably not expedient to devote here any space to the minutiæ of the technique of röntgentherapy[1]; and the technical and biological considerations may be abbreviated to a few necessary notes of explanation.

Owing to the differences of the radiosensitiveness of the various tissues, doses which are sufficient to destroy or modify pathological cells are not always harmless for the normal tissues. The skin, in particular, which itself is very sensitive to the X-rays, allows the absorption of much larger doses than can possibly pass through it to the deeper organs. The skin is therefore the chief barrier to deep röntgentherapy.

Various means have been devised for protecting the skin while permitting the passage through it of large quantities of effective rays. Our colleague, Dr. Pfahler of Philadelphia, was one of the first to introduce the use of a leather filter for this purpose. Aluminum filters are also utilized, the thickness varying from one to four millimeters. The writer employs at least three or four millimeters of aluminum plus a thickness of sole leather as a filter in most of his deep röntgentherapeutic work; and sometimes the thickness of aluminum is increased to seven or eight millimeters.

The reasons for the employment of *filters* are easily understood. The emanations from the röntgen tube consist of a bundle of rays of varying penetration. The softer rays do not pass farther than the skin; the most penetrating rays are capable of traversing not only the skin, but heavy filters, and of passing on into the deeper tissues. Filters serve to sift out the softer rays so that the skin is subjected only to the influence of the very hard rays, a maximum proportion of which are thus allowed to pass into, and be absorbed by, the deeper tissues. The present-day tendency in röntgentherapy, both in superficial and deep lesions, is to use harder rays. It is quite possible that the very hardest obtainable rays are not the most desirable nor the most effective, and that the optimum will fall somewhat short of the hardest obtainable rays; nevertheless, in the writer's opinion, harder rays are needed than are at present available even with the Coolidge tube in its present stage of development, and with the present forms of apparatus and tubes the hardest obtainable rays are utilized.

Besides filtration, special means have been sought for *desensitizing the skin*, among them being the production of superficial anæmia by the application of ice, by the injection or electrical introduction of adrenalin into the skin, and by the use of compression. Considerably more than the erythema doses may be safely passed through the skin thus rendered anæmic; but with the progress of our knowledge of filtration and the introduction of more powerful sources of röntgen rays, the need of thus desensitizing the skin seems to have diminished, and it does not find a place in our present technique.

The progress of deep röntgentherapy has gone hand in hand with the increase of our knowledge of filtration and cross-fire irradiation. *Cross-fire irradiation* is the term applied to the method by which one passes a bundle of rays of high penetration through the different surfaces of skin which surround the region under treatment; for instance, the anterior, posterior, and lateral aspects of the trunk if one is irradiating an abdominal tumor, or the anterior, posterior, and lateral aspects of the neck in the treatment of goiter. The principle of cross-fire irradiation may be considerably elaborated by dividing each of the surfaces in the neighborhood of the organ into a number of areas and directing the rays through each of these areas in succession, carefully protecting all except the one actually under treatment, thus introducing through each skin area the maximum dosage of filtered ray which the superficial tissues can

[1]See two recent papers in press:
(a) James T. Case, M.D. Coolidge tube technic in deep röntgentherapy. Read before the American Electro-Therapeutic Association, Battle Creek, Michigan, September 15 to 17, 1914. (b) James T. Case, M.D., and Llewelyn L. Jones, M. D. Technic and recent results in deep röntgentherapy. Read before the American Röntgen Ray Society, September 9 to 12, 1914, Cleveland, Ohio.

tolerate. The amount of effective rays which reach the deeper tissues is increased as many times as there are ports of entry. In certain locations where the skin overlying the organ is very loose, it is possible, by sliding the skin about, to deliver several doses directly over the organ under treatment without overtreating any section of the skin.

It was formerly held that for the irradiation of deeper parts the tube should be relatively farther from the skin than when treating superficial lesions. Inasmuch as the intensity of the X-rays varies inversely with the square of the distance from the anode to the part under consideration, with a shorter *focus-skin distance*, it is evident that the tube being brought nearer to the skin, the length of time required to deliver a certain dosage to a deep-lying structure will be proportionally diminished. For instance, with a tube fourteen inches from the skin ($14^2=196$), nearly five and one-half times longer will be required to deliver a certain dosage to the skin than when the focus-skin distance is only six inches ($6^2=36$). The former objection to the short focus-skin distance was the much greater danger of injury to the skin. Since the introduction of filtration methods, however, this danger of skin injury is eliminated within certain limits, and it is now possible to bring the tube much closer to the skin, thus materially shortening the time required to administer an effective dose to the deep parts. If it were not for this possibility, the length of time needed for the application of deep röntgentherapy would almost preclude its employment.

Wider application of the improved method. These three developments, therefore—the use of filtered rays of high penetration, the method of cross-fire irradiation, and the close approximation of the tube to the skin—have rendered possible the practical employment of effective doses of röntgen rays, aggregating forty to one hundred times the maximum doses considered safe nine or ten years ago, in a number of deep-seated affections which hitherto had responded uncertainly to the efforts of röntgenologists; and this great advance has been accomplished without so greatly increasing the necessary labor as to preclude its practical employment. It must be added, however, that the dangers of attempting the unskilled application of this potent means have been in the same degree increased. Röntgentherapy should be vigorously but carefully and skillfully given. As one expert has aptly put it, the possession of a röntgen apparatus is no more a guarantee of skill in röntgenology than is the possession of surgical instruments a guarantee of skill in surgery.

Biological effects of the röntgen rays. It is a generally accepted postulate that small röntgen doses exercise a stimulating effect upon cell development, while the larger doses give rise to depressant effects. A given dose will be more or less stimulating or more or less depressant to a certain tissue, depending upon its nature, for the rays seem to exercise a selective action. In general it may be stated that the cells most affected by the röntgen ray are those in which the reproductive activities are the greatest, those in which the karyokinetic process is most active and whose morphology and function are the least highly developed. Before beginning treatment it is therefore essential to decide first which therapeutic effect of the X-rays is desired.

In relatively few instances of deep therapy is the stimulating effect of the röntgen rays desirable; most often a depressant effect is needed, and one must exercise the greatest care to make sure that he is not giving a dose so small that it may be stimulant, lest he counteract the therapeutic effect it is desired to secure. This is perhaps most essential in the treatment of malignant conditions, as will be emphasized by another speaker of the evening, but it is also true in most benign lesions. It may be declared that for efficient deep röntgentherapy a constant source of rays of maximum penetration must be assured. It should further be considered absolutely essential to every procedure of röntgentherapy that the dosage be measured as accurately as the present developments of instruments will permit. The writer recognizes that absolute accuracy is not obtainable; nevertheless, it is possible to make such a close estimate of the number of x units delivered through a filter that any competent

röntgenologist will understand and be able to duplicate the technique and the results in a similar case. In fact, it would seem desirable if the practice of röntgentherapy could be limited to those who will equip themselves to administer dosage in definite measurements.

With these introductory remarks the writer will proceed to a brief consideration of some of the more important non-malignant diseases in which deep röntgen irradiation has been employed or in which its use seems indicated.

Leukæmia. American physicians were the first to use röntgentherapy in leukæmia, Pusey reporting the first case in 1902. Pancoast, Schultz, Senn, Williams, Kleineberger, Pfahler, Boggs, and Johnston are others who have reported excellent symptomatic cures. Pancoast particularly has contributed greatly to our knowledge of this subject.

It has been aptly stated that röntgentherapy in leukæmia is a symptomatic, transitory, therapeutic means. Practically all cases relapse sooner or later and ultimately die, although there are claimed a few exceptional permanent cures. Nevertheless, the prognosis with röntgentherapy is so much more favorable, as far as uniformity of symptomatic improvement and lengthening of life are concerned, that the therapeutic use of the X-rays finds in this disease one of its most valuable applications.

In the myeloid form the blood picture generally approaches the normal. In the lymphatic form the pathologically changed blood-cells remain practically the same, in spite of the fact that the white cell count may show considerable diminution. On the whole, the effect is more favorable in lymphatic than in myelogenous leukæmia. Béclère, in 1913, reported 110 cases of leukæmia treated with the röntgen rays—twelve lymphatic, ninety-three myelogenous, and five acute forms. The lymphatic cases returned almost to normal. In the myelogenous form there was a transitory improvement with always a recurrence. In the acute cases the effects were unfavorable. Cases which have been manifest for less than a year, and in which the leukæmia is not very severe in grade, offer more favorable prognosis than others. Some cases, both of the myelogenous and lymphatic forms, are refractory to röntgentherapy and give unfavorable results, even as far as symptomatic cure is concerned. In all acute forms the use of the X-rays is contra-indicated.

Favorable signs of successful röntgen treatment are an increase in the hæmoglobin or of the hæmoglobin and the red cells, as well as general improvement in the patient's condition. A diminution of the leukocyte count does not, as a rule, appear until a little later. In fact, there may be a temporary increase in the number of leukocytes preceding the fall.

At first treatments were directed over the enlarged spleen in splenomyelogenous leukæmia and over the spleen and other enlarged lymphatic structures in lymphatic leukæmia. While some of the long bones had been treated perfunctorily, no definite campaign had been introduced against the bone-marrow until the work of Pancoast.

In the light of modern research concerning the pathology of this disease, leukæmia may be regarded as a sort of cancer of the blood, the bone-marrow being considered the primary focus of the disease and the lymphatic enlargements as metastases. This is certainly borne out by the greater success of the plan of therapeusis whereby the most energetic treatment is directed against the primary foci in the bone-marrow, as recommended by Pancoast, rather than against the secondary manifestations of the disease in the spleen and other lymphatic organs. The writer has again and again observed that applications over the long bones alone have resulted in a diminution in the size of the spleen and a reduction in the white cell count without any direct exposure of the spleen itself. There are, however, exceptional cases which do not thus respond. The average prolongation of life may be estimated at about two years.

Pancoast and several others explain the frequent symptomatic cures, followed by a varying period of quiescence, with the older method of treatment, as follows: Röntgenization of the spleen and other lymphatic enlargements, through direct destruction of

certain cells, thereby diminishes the size of these organs. Leukotoxic substances, having the power of destroying large numbers of leukocytes, are produced and liberated into the blood, thus diminishing the white cell count. These leukotoxic substances seem also to exercise an inhibitory effect upon the red-forming activities of the bone-marrow.

Linser and Helber found that this leukotoxic action could be demonstrated both *in vitro* and *in vivo*. They observed, for example, that the injection of blood serum of an irradiated rabbit into a second rabbit causes a decrease in leukocytes instead of the increase which should follow the injection of normal serum. A number of other workers, however, have achieved only negative results, and the evidence concerning the existence of a röntgen leukotoxin is on the whole still insufficient.

There are some dangers attending the röntgenization of leukæmic patients, the avoidance of which requires considerable skill and judgment. There is danger of toxæmia following over-exposures of the spleen and lymphatics and other tissues especially susceptible to the röntgen rays. This danger is especially great if the early efforts are directed against the spleen; later on, after a sort of tolerance has been established by treatment of the bone-marrow, applications may be directed toward the spleen with considerably less danger of toxæmia. It is probable that in certain instances death has been produced by overwhelming toxæmia resulting from an over-exposure of lymphatic structures at one sitting. The temporary increase in the white cell count which may occur during the period of reduction of the enlarged glands should not be considered as an indication of failure, as persistence in the treatment will finally reduce the count. If toxæmia seems imminent, the dosage should be diminished or the treatments should be temporarily discontinued. In very severe cases only one area should be treated daily, and one will thus wish to treat the patient every day. When there is less danger of toxæmia, several areas may be treated in one day, and the number of days of treatment in each month will be thus lessened.

The danger of "burns" should be considered, but if the first principles underlying the therapeutic action of the rays is understood, no "burns" should occur. The bone-marrow treatment, through furnishing more areas for the entry of the rays, involves less danger of skin injury than treatment confined to the lymphatic structures alone.

The duration of the course of treatment is variable and extremely difficult to decide upon. Unless the patient can be depended upon for at least three months' treatment, röntgentherapy should not be started, for if the treatment is stopped too soon a relapse is almost certain to occur, and it has been the universal experience of röntgenologists that each relapse shows greater obstinacy in its response to treatment. Pancoast has expressed the belief that a rapid symptomatic cure renders ultimate failure almost certain. It is not sufficient to correct the leukocyte count and to cause the various enlargements to disappear. No matter how healthy and vigorous the patient may seem to be, continuation of the treatment should be insisted upon until the differential blood count has returned to normal and the abnormal blood elements have disappeared. Even then differential blood counts must be insisted upon at frequent intervals, and, at the first sign of recurrence repetition of the systematic course of treatment should be begun at once.

Let it be repeated that after a course of röntgen treatment has once been mapped out it should not be discontinued until all the areas mapped out have been gone over three or four times and the abnormal cell elements have disappeared, for an earlier cessation of treatment practically precludes the probability of a cure, even a symptomatic cure. The prognosis in any case is unfavorable as to cure, even after X-ray treatment, although the symptomatic cure is better than with any other therapeutic method.

Hodgkin's disease. Hodgkin's disease is a condition in which very satisfactory results have followed röntgentherapy, though the question of final cure still remains. Indeed, except for the hope which is held out to us in recent developments in serum therapy, rönt-

genization is the only rational method available in this disease.

The prognosis is still undetermined. There is greater likelihood of cure in these cases than in true leukæmia. Pancoast believes the proportion of cures is between 10 and 20 per cent, and in all of the cases which respond to treatment one may expect many months or even years of comparative relief from symptoms. Some patients who, at the beginning of treatment, are helpless from weakness regain strength sufficiently to resume their usual occupations.

In contrast to leukæmia, Hodgkin's disease is a local rather than a general condition. The effects of röntgenization appear to be local, and if any leukotoxin is produced, it does not behave as in leukæmia. Remote lesions are not influenced; there is no effect upon lesions other than in the structures exposed.

Before outlining the treatment it is necessary to study the chest röntgenographically to determine the extent of the mediastinal involvement, and re-examination by means of röntgenograms at suitable intervals may serve to mark the progress of the disease.

As in leukæmia, there is a danger of toxæmia from exposure over too large a mass of lymphatic structures at one sitting. In fact, the toxæmia may appear within the first few hours after heavy treatment. The evidences of toxæmia (headache, lassitude, even nausea and vomiting) constitute the principal guide as to the frequency of treatment.

There is still another danger in these cases, especially when the enlarged glands embarrass the respiration. It is a common observation that the decrease in size which almost invariably follows röntgenization of these lymphatic structures is preceded by a temporary swelling, which appears within a few hours after treatment, and may be very marked. The treatment of too many areas in the neighborhood of the trachea at one sitting may result in serious respiratory embarrassment from the primary, though transient, swelling of the lymphatics which is almost certain to occur.

Various forms of anæmia. At the outset it should be admitted that as yet there is little clinical evidence to warrant the use of röntgentherapy; yet in certain forms of anæmia, röntgenization should, theoretically, exercise a beneficial influence. Small doses of röntgen rays should stimulate the bone-marrow to increased activity. Large doses should exercise a destructive action. In the cases which have been reported it has appeared that as long as the bone-marrow is still capable of responding to stimulation benefit may be expected, but when the degeneration of the bone-marrow has so far progressed that it no longer reacts to stimuli, no good results can be hoped for.

As a general rule, however, generally recognized therapeutic means should be employed in conjunction with röntgentherapy, especially such remedial measures as tend to have a general or constitutional effect, for with the exception of a few blood disorders, the action of the röntgen rays is essentially a local action. The writer believes that a trial of röntgen treatment is worth while in every obstinate case, the blood being examined at short intervals in order to decide as to the value of the measure. When the anæmia is not severe, röntgenization should give way entirely to other methods.

In *pernicious anæmia* the röntgentherapy is not only still in the experimental stage, but is attended by such dangers from toxic effects that its use should be restricted to such cases as are distinctly not of toxic origin.

The technique is, in general, the same as for myeloid leukæmia, except that the dosage is smaller. Filtered small doses for stimulating effect should be applied especially to the knees, shoulders, and elbows, and occasionally to the sternum.

In *splenic anæmia*, at least according to present theories, röntgentherapy should be highly beneficial. Up to the present time the results of röntgen treatment in this condition have not been very encouraging, but the introduction of the Coolidge tube and the other improvements which have been mentioned earlier in this paper inspire hope that in the future the effects of filtered röntgentherapy directed over the spleen, utilizing the cross-fire method by numerous ports of entry, will simulate the effects of surgical

treatment by splenectomy. If splenectomy is a curative means, then also röntgentherapy should be beneficial. Very heavy doses will be indicated, utilizing the smallest possible areas of entry and as many fields of irradiation as possible, the only limitation, with proper technique, being the danger of producing toxic effects.

The thyroid gland. The hypertrophic goiter of adolescence responds fairly well and may be permanently and considerably reduced in size, although complete disappearance of the enlargement is hardly to be expected. In *cystic goiter* the effects of röntgenization are very unsatisfactory, practically the only result of prolonged treatment being a possible arrest of the growth of the gland.

In *Graves' disease*, however, röntgentherapy has given excellent results in the hands of the majority of experienced röntgenologists. The treatment is not merely symptomatic, but because of its effect in depressing the secretory function, has the character of an etiologic therapy, since it is aimed at the cause of a disease whose essential pathological feature is an exacerbation or aberration of its secretory functions, with resulting toxæmia.

The effect of the röntgen rays upon glandular secretions in general is especially marked, the secretion of certain accessible glands being almost completely inhibited after röntgen exposure. This is especially noticeable after intensive applications to the neck, jaw, and face in the treatment of lesions of the lip or tongue, as, for instance, carcinoma. After treating carcinoma of the lip and the related glandular areas, giving massive doses under strong filtration, the writer has often observed that within twelve hours the patient's salivary secretions have been dried up and have remained so for many days. When series after series of such treatments are given, the drying up of the salivary secretions comes to be a very great inconvenience to the patient. This by-effect of the röntgen rays on the salivary glands in treating carcinoma of the lip or tongue must strengthen our faith in the efficacy of röntgenization of the thyroid gland where the patient's symptoms are due to an abnormal secretory activity. This depressant effect constitutes the basis for our plan of treatment, and indicates that a very heavy dosage must be given in order to secure certain results.

The permanent effects in Graves' disease depend upon the course of the disease before treatment. The shorter the duration of the disease or the shorter the time since there was any marked change for the worse the more permanent the results. A pathological condition that has been uniform for years demands long treatment. Cases that have rapidly increased in severity yield quickly after the beginning of treatment. Where acute exacerbations occur in chronic cases, röntgen treatment is indicated with fair prospect of good results, but in chronic cases without exacerbation, or with only slight exacerbation, especially when myocarditis threatens, röntgenization is not indicated.

In favorable cases the nervousness and tremors are the first symptoms to subside. There is next an improvement in the tachycardia and respiratory symptoms, and last of all the exophthalmos and glandular enlargement are seen to diminish. The enlargement of the gland, the protrusion of the eyes, and some tachycardia are likely to persist, but there is good prospect that the distressing symptoms will be permanently improved.

It is highly important that attention should be given to general therapeutic considerations in these cases, because of the toxic symptoms which may develop. Not every case will be cured by any means, but the method is worthy of trial in every case where it seems desirable to avoid operation, and it may even be required in connection with operation in certain cases where the expected good results do not appear or are not sufficiently marked.

It has recently become a practice with some physicians to require a röntgen examination of the chest in all cases of thyroid enlargement to determine whether or not the thymus is enlarged. Even where no thymic enlargement can be demonstrated, pre-operative treatments applied to the thymic, as well as the thyroid regions, improve the prospect of beneficial results.

The writer here would like to take issue with the opinion often heard that röntgen

treatment is not indicated in thyroid cases, for the reason that when it fails operation is rendered much more hazardous and difficult, owing to increased adhesions and greater danger of hæmorrhage. The majority of experienced röntgenologists will agree in this point at issue, disputing the opinion that röntgen treatment causes adhesions which make operation more difficult. As a matter of fact, pre-operative röntgen treatment should tend to thicken the capsule and the walls of the smaller blood-vessels, which theoretically would favor the outcome of the operation instead of hindering it. Adhesions and unusual hæmorrhage are encountered in just as many cases never treated by the X-rays as in those cases which have undergone pre-operative röntgenization.

Patience is required in the handling of these cases. No patient should be accepted for röntgen treatment unless the röntgenologist can be assured that the patient can be depended upon for at least four series of treatments, covering a period of twelve or thirteen weeks. With our modern technique the majority of these cases will show a favorable response in less time than this. Occasionally one finds such improvement that further treatment seems needless. In cases of apparent failure of X-ray treatment, where operation is finally decided upon, nothing has been done to jeopardize the patient's interest.

Thymus. Röntgenization in the treatment of thymic asthma is a well-established therapeutic measure. In infants a very short series of treatments is adequate to produce results which seem almost miraculous. In older children, and particularly in adults, the treatment must be considerably prolonged. Our utmost technical skill and judgment in the arrangement of areas for cross-fire are demanded. In such cases the writer irradiates the thymus through from twelve to sixteen areas—at least four anterior, four posterior, one obliquely through each supra-clavicular space, and one or two obliquely through each axillary region, the arm upraised.

The writer has seen nothing in the way of toxic effects following massive dosage in this condition, although such effects should be watched for and the treatment arrested accordingly. Great credit is due to Lange of Cincinnati, Stoerck, and others who have carried on extensive experimental work on röntgen therapy in this condition.

As above noted, röntgenization of the thymus is probably indicated in most cases of Graves' disease in addition to the treatment over the thyroid gland itself.

Uterine myomata. Concerning the use of röntgentherapy in gynecology, there has arisen a great deal of discussion and considerable difference of opinion. Some gynecologists summarily dismiss the subject as not worthy of consideration. On the other hand, some have become so enthusiastic as to prophesy that in the future the majority of women suffering from myomata and metropathies who have recourse to a hospital will be treated by röntgentherapy.

There is a middle-of-the-road tendency in this country and England, however, to discount somewhat the estimate placed by our Continental colleagues upon the value of röntgentherapy in gynecology. Donald, of Manchester, for instance, reports a series of 201 operated cases in which there were complications in forty-four, or nearly one-fourth of the cases; thirteen ovarian cysts, twelve cases of red degeneration, six cases of suppuration in tube or ovary, four cases of appendicitis, five cases of calcareous degeneration, two cases of fibrocystic tumor of the uterus, two cases of carcinoma in the fibroid, two cases of adenomyoma, one case of necrosed polypus, and one case of hydroperitoneum.

It is manifestly important that a correct diagnosis be made before the case is submitted to the röntgenologist, and yet nearly all the complications in the forty-four cases referred to by Donald could have been, and doubtless were, diagnosed prior to operation, and hence would be declared to indicate operation rather than röntgentherapy. The difficulties in gynecological diagnosis are most common in the effort to differentiate inflammatory masses and adherent ovarian or tubal tumors from fibroid tumors of the uterus, and especially when they occur in association with uterine fibroids. Malignant degeneration of tumors,

which unfortunately occurs, though in a very small percentage of cases, is another contra-indication to X-ray treatment, except as a last resort in inoperable cases and as a post-operative measure. The writer is an advocate of routine post-operative röntgenization in all malignant cases.

In contrast to the foregoing array of difficulties and discouragements in the way of röntgentherapy of uterine disease is the report recently received from Dr. Gauss of Freiburg summarizing all the cases of myoma and metropathy treated by X-ray therapy of which reports had been published prior to January, 1914. The following tabulation of 1395 cases is furnished by Johannes of the Freiburg Frauenklinik. Only such reports were included as gave specific information as to the dosage and technique employed.

	Number of the treated cases	Percentage of		
		Cure	Death	Recurrence
Group I (50–175x).....	693	72	0.5	4
Group II (175–500x)....	544	82	0	3
Group III (500–1500x)..	158	95	0	0
Total.....	1,395			

It will be seen that corresponding to the increase of Kienboeck's X units there was an increase in the percentage of cures from 72 per cent to 95 per cent. It should be borne in mind that these cases were all of them studied by gynecologists previous to the beginning of röntgentherapy and the therapeutic effects judged by them, not by the röntgen therapeutists. The deaths which occurred in the first series could not be, in any way, attributed to the röntgentherapy.

Albers-Schoenberg, who is the father of deep röntgentherapy as applied to gynecology, summarizes his views on this subject. These views have been incorporated with the results of the writer's experience in the following paragraphs:

1. Röntgen deep therapy is based upon the fact that the röntgen ray has a decided deleterious effect upon the male and female glands. The effect on the myomata is primarily through the ovaries, but certainly in the majority of cases there is a direct effect upon the tumor-cells themselves, manifested by decrease in the size of the tumor. The report of Kelly and Burnham on the direct effect of the gamma rays of radium upon myomatous tissue supports this view.

2. The symptoms caused by myomata improve and are sometimes entirely overcome. The hæmorrhage may be changed into the normal menstrual type or a complete cessation may be brought about.

3. The general conditions improve and the symptoms of the menopause are gnerally mild. In suitable cases the percentage of complete recoveries is high, yet it must be admitted that a certain number of myomata are refractory.

4. A certain percentage of myomata now, as before, must be operated upon. Not all are suited for röntgen treatment.

5. There is some danger of the appearance in the skin of injuries which are not manifest until some time after the cessation of the treatment. The future will show just how much they are to be feared. At the present time we are justified in believing that the late appearance of injury to the skin cannot occur unless the skin has suffered from a röntgen dermatitis of the first degree. It is essential that heavy dosage be applied, yet with careful observance of all the conditions necessary for the administration of deep röntgentherapy as much as twenty x units under the filter may be given as a routine without producing a röntgen dermatitis. As many as six or eight series of treatments, each area receiving 20 x, may be given each three or four weeks without producing any noticeable skin effects, not even atrophy of the skin. The writer would warn against larger doses except in cancer cases.

The indications and contra-indications for treatment have been fully stated by Pfahler in the *Journal of the American Medical Association*, August 22, 1914. We may summarize as the chief indications for deep röntgentherapy in gynecology the treatment of climacteric and other known benign hæmorrhages in older women, in whom the anatomical character of the endometrium should be ascertained by microscopic examination before röntgentherapy is decided upon.

It has also been urged as a contra-indication to deep röntgentherapy that, should the röntgen treatment fail and operation subsequently be decided upon, the intensive irradiation will have stimulated the formation of multiple adhesions which will interfere seriously with the operation. In fact, one prominent gynecologist, in confirmation of this argument, cited a case in which, following intensive irradiation in a case of uterine hæmorrhage, it was finally deemed necessary

to operate. At laparotomy the pelvic organs were found matted together by multiple adhesions which the operating surgeon attributed to röntgentherapy. The writer doubts very much the *post hoc propter hoc* nature of this argument, but he has not, until recently, had an opportunity to contradict it definitely. It seems, however, that the following case controverts any such argument that may be advanced:

The patient, E. C., age 62, was first referred for treatment on April 10, 1914, by Dr. W. F. Martin. Mr. C. had an extensive carcinomatous involvement of the prostate with 20 ounces of residual urine. By reason of carcinomatous extension to the bowel, it was not deemed feasible to operate. This opinion was concurred in by Dr. E. Wyllys Andrews, whom the patient later consulted, and palliative treatment was advised. Accordingly röntgen treatments were begun very much after the plan followed in treating uterine myoma, except that the doses were made heavier, twenty-five and sometimes thirty X units being given over the various skin areas chosen for cross-fire, the carcinomatous area being approached through twenty-six areas; twelve anterior, twelve posterior, and two perineal. Only palliative results were hoped for, but the results were awaited with great interest. The residual urine was reduced to 2 ounces within four weeks and the prostate was considerably diminished in size.

On February 18, 1915, ten months after treatment was begun, the patient meanwhile having received nine series of X-ray treatments, the constriction of the bowel by the malignant growth or its cicatrix seemed to demand colostomy. Therefore Dr. Kellogg decided to operate, the opportunity being utilized to explore the pelvis carefully. In view of the fact that the patient had been subjected to such an extensive course of X-ray therapeusis, nearly 6,000 X units measured under the filter having been administered during ten months, the appearance of the intestine was noted with great interest, to discover possible adhesions, the result of the röntgenization. The small bowel was entirely free from adhesions. The iliac colon was adherent near the iliopelvic junction but in a manner very commonly seen at operation in patients who have never taken any röntgen treatment. Just below the pelvirectal junction, the bowel was found tightly adherent, the adhesions being confined to an area not larger than a pigeon's egg, accurately coinciding with the site of the carcinoma. Proctoscopic examination of the adherent area showed an annular constriction with some ulceration of the mucosa which bled easily on being touched. A colostomy was performed in the usual manner.

The foregoing case, it seems to the writer, proves conclusively that there is no danger of adhesions following intensive röntgentherapy directed toward the pelvis.

Prostatic hypertrophy. Gradually accumulating experience seems to show that the field of usefulness in deep röntgentherapy will include a certain number of cases of prostatic hypertrophy. The writer does not care to urge this form of treatment for any case where surgery can be carried out, but deep röntgenization may be recommended as a partial substitute for surgery in cases where surgical interference is inadvisable. In general, the technique is the same as that employed in the treatment of uterine myomata. Both anterior and posterior areas should be employed and several perineal areas. In the latter areas a somewhat smaller dosage should be administered because of the greater radiosensitiveness of the skin in these parts. The sensitive scrotum, if desired, may be protected from the effect of the ray, for there is probably no particular advantage from the irradiation of the testicles. The writer has seen the amount of residual urine diminished from 16 to 2 ounces within four weeks.

The treatment of these cases should be pursued energetically, but with the greatest care, and should be conducted for a sufficiently long time to insure a permanent reduction in the size of the gland. It is difficult to speak with certainty on account of the lack of reported cases, but certainly here is a field for the further development of deep röntgentherapy. As in the case of uterine fibroids, it is, of course, important that a correct diagnosis be made before beginning the röntgen treatment.

Tuberculous conditions. In practically all forms of tuberculosis, röntgentherapy has been tried out. Until within the last two years the verdict was almost unanimous that, in glandular and skin tuberculosis, röntgentherapy was reliable in the production of good results; in bone and joint tuberculosis the results were unsatisfactory and questionable; and that in peritoneal, pulmonary, and urinary tract tuberculosis there were no results to warrant the recommendation of this method of treatment.

Recent work by Kuepferle in de la Camp's

clinic in Freiburg has required us to revise our decision concerning the use of röntgentherapy in *pulmonary tuberculosis*. Gibson of Denver was one of the first to report good results in pulmonary tuberculosis, but he claimed such a high percentage of favorable results without making any very definite statements as to the actual results secured or the technique employed that no great confidence was inspired in his statements. Nevertheless, the experimental work of Kuepferle[1] on animal tuberculosis and his recent report of forty-four cases in man causes us to reconsider the claims of Gibson.

Several investigators, including Leonard, Pancoast, and others, have called attention to the fact that in cases which are described as tuberculous cervical adenitis, röntgenization of the cervical glands has caused a disappearance of the apical signs of tuberculosis. Pancoast, however, issued a warning that, in cases of mixed infection, röntgenization might do harm rather than good.

Kuepferle's experiments are of extreme interest, especially his observation that recent and developing tuberculous foci, as well as old caseous processes of not too long standing, could be favorably influenced in the animal experiments. This is of special importance in considering the effect on human beings, where it is well known that fresh foci caused by reinfection occur alongside the older foci. The characteristic thing about all tuberculous lungs treated by röntgen rays is the lack of specific tubercular proliferation tissue and the great richness in young connective tissue as seen in the microscopic studies. The connective tissue not only replaces the granulation tissue, but penetrates the caseous and necrosing foci and surrounds them, so that there is a well-marked line of demarcation between the tuberculous foci and the normal lung-tissue.

In the lungs of control animals not subjected to röntgentherapy there were always more or less well-developed caseous foci surrounded by luxuriantly proliferating granulation tissue while no connective-tissue development could be seen. It seems reasonable to conclude from such experimental results that in proper doses the röntgen rays destroy tuberculous granulation tissue and act as a stimulant to the development of young connective tissue. On the one hand the pathological granulation tissue caused by the infection is destroyed and on the other hand connective-tissue healing is powerfully stimulated. The tubercle bacillus itself is hardly influenced directly, as is shown by positive results of inoculation of the tissues of röntgenized animals into guinea pigs. It was noted, however, that less severe symptoms were caused by intraperitoneal injection of material from röntgenized tuberculous lungs than from tuberculous lungs which had not been treated.

Kuepferle reports on forty-four patients in different stages and with different forms of the disease. At first the patients were not selected, far-advanced and hopeless cases being included in order to best determine the effect on far-advanced processes. The forty-four cases were divided into three groups. In the first group there were nineteen cases in which there were active processes with febrile and subfebrile temperature. Seven of these, in addition to the pulmonary infection, had marked enlargement of the cervical and bronchopulmonary glands. In these patients not only the diseased part of the lung but also the lymph-glands were treated. In all there was a retrogression in clinical symptoms, decrease in cough and expectoration, and gradual decline in fever. The average duration of treatment was thirteen weeks. Some of the stubborn cases showed a recurrent rise of temperature. All such were given several series of treatments at long intervals until there was complete disappearance of the fever and retrogression of the symptoms. Four patients have been examined from nine to eleven months following treatment and have been found well and free from symptoms.

In the second group were included fourteen cases, some with disseminated and some with confluent foci. All of these were also favorably affected. Of the fourteen, ten are clinically cured and dismissed from treatment. The four remaining are yet under treatment. The longest series of treatments extended over

[1] Kuepferle, L. Strahlentherapie, 1915, v, No. 2.

thirty-two weeks, the patient having a recurrence of fever. This patient was able to work at the time of discharge.

Eleven patients were included in the third group. Five of the eleven were complicated by tubercular disease of the larynx or peritoneum. In all the process was extensive and in some cavitation had taken place to a marked degree. These patients showed only temporary improvement. In general, they were very much more sensitive to the effect of the rays than the patients with incipient disease.

Although final judgment is withheld, the results thus far secured are very encouraging and emphasize the fact that in this day of advanced technique, improved tubes, and better apparatus, too much reliance should not be placed upon the negative results of the older methods of röntgentherapy.

Cases best suited for treatment are those in the earlier stages of the disease with slight signs of disintegration, even though there may be slight rise of temperature. The advanced cases are ameliorated, but the improvements are not proportionately marked. Surely the good results thus far secured warrant further trial of this method.

In the treatment Kuepferle emphasizes that the laws of deep röntgenization must be followed. Homogenous rays must be secured, and fortunately the modern improvements in technique make this possible. Heavy filtration, relatively short focus-skin distance, and multiple field irradiation are other features of the technique. In severe cases from 15 to 20 X over one or two fields is the maximum daily dosage.

In *skin tuberculosis* the results of röntgentherapy are very satisfactory. Details as to results of superficial lesions are out of place in this paper.

In *glandular tuberculosis*, the results of different investigators vary, but Crane's investigations suggest that the investigators with poor results have failed to observe the principles which should govern the treatment of such cases.

In some experimental work comparing the opsonic index following vaccine injections with the opsonic index following X-ray treatments, Dr. Crane was able to show that the opsonic curve was essentially the same under both conditions. This indicates that the interval between X-ray treatments should be the same as the interval between vaccine injections, and that if the X-ray treatments are too severe or over too large an area, the reaction would be the same as if too large an injection of vaccine had been given. In this way a negative phase could be produced from which the patient might not be able to recover.

Dr. Crane concluded that the duration of exposure and the extent of the diseased tissue exposed should be so regulated as to produce either a small negative phase or none at all. The repetition of exposure should, as far as possible, be governed by the duration of the negative and positive phases. It follows as a corollary that it is not necessary to expose the whole area in order to bring about complete recovery. Dr. Crane believes that, as a rule, exposures should not be repeated oftener than twice a week, and probably in most cases at less frequent intervals, to secure the maximum results and to avoid prolonged or incurable negative phases. The writer urges careful consideration of Dr. Crane's investigations concerning the treatment of this disease.

The results in *bone and joint tuberculosis* probably depend upon the same principles which govern the treatment in glandular tuberculosis, as just stated. American röntgenologists have not reported the good results which have been claimed by many French and German workers in the treatment of these conditions, but in view of the scientific standing of the men whose work is attended by success, further effort in bone and joint conditions seems indicated.

We still record negative results in the treatment of *tuberculosis of the urinary tract* and in *tuberculous peritonitis*, the number of favorably affected cases being still too small to warrant any definite conclusions.

In the foregoing pages the writer has sought, not only to emphasize the usefulness of deep röntgen irradiation in certain conditions where the value of this remedial agent has already been acknowledged, but also to

point out a number of fields in which, theoretically at least, this agent would be of value, but where up to the present time sufficient clinical evidence has not been accumulated under the conditions of accuracy which should attend the present-day employment of deep röntgentherapy. Emphasis has been laid upon the necessity of accuracy in dosage, skill in manipulation of instruments, filters, and lead protection, and judgment as to the dosage indicated. As already intimated, the ownership of a röntgen installation by no means signifies skill in its use. All röntgen treatments should be recorded in such terms that any röntgen worker will understand the exact dosage and be able to duplicate the treatment.

There is, at the present moment, no organized literature on the subject of deep röntgentherapy as a whole. Numerous papers have appeared on the various phases of treatment, particularly those phases relating to gynecology, but what the writer would like to urge very emphatically is that in view of the renewed possibilities from this method of treatment, no case in which röntgentherapy is theoretically indicated should be denied a trial of this measure merely because the literature reports unfavorable results. In other words, much of the literature of deep röntgentherapy must be rewritten and the writer ventures the opinion that many of the conclusions will be changed in the revision.

DISINFECTION OF THE HANDS AND ABDOMINAL SKIN BEFORE OPERATION

By ELLICE McDONALD, M.D., New York

DISINFECTION of the hands is one of the most important subjects in surgery. It is necessary to cleanse the hands before every operation in order to prevent the possibility of infection. The most commonly used substances heretofore used for this purpose were alcohol and the mercury salts.

Alcohol is a weak germicide, and its value depends more upon its cleansing properties than upon its actual germicidal powers. Koch grew spores after 110 days in alcohol. Goenner grew streptococcus after fifteen minutes in alcohol, and Senger, staphylococcus aureus after twenty minutes. My own experiments have shown the germicidal strength of alcohol to be of no great value; cultures of staphylococcus aureus have not been killed upon the hands by 90 per cent alcohol in five minutes. Tjaden states as a result of his experiments, and from a review of the work of Epstein, Ahlfeld, Saul, Paten, Fürbringer, Reinicke, and Krönig, that this is the most efficient percentage of alcohol. However, I believe that the germicidal action of alcohol is so slight that consideration of the percentage is of no great consequence. A proof of this is the large percentage of alcohol which is required, acting even as an antiseptic, to prevent decomposition in various proprietary liquid foods and medicines. The virtue of alcohol in cleansing the hands is exerted more as a chemical solvent than as a germicide. Alcohol, although a solvent of free fatty acid, will not dissolve the fat as found in the skin; i.e., the glyceride. The ideal skin disinfectant should be a *fat solvent.*

According to the experiments of Minervine, it took two minutes for 70 per cent alcohol to kill the staphylococci, while the same organism survived in 3 days' exposure in 99 per cent.

Harrington and Walker, in their useful article, came to the following conclusion:

"Against dry bacteria, absolute alcohol and ordinary commercial alcohol are wholly devoid of bactericidal power, even with twenty-four hours' direct contact, and other preparations of alcohol containing more than 70 per cent by volume are weak in this regard, accord-

ing to their content of alcohol—the stronger in alcohol the weaker in action.

"The most effective dilutions of alcohol against the strongly resistant (non-sporing) bacteria, such as the pus organisms, in the dry state, are those containing from 60 to 70 per cent by volume, which strengths are equally efficient against the same organisms in a moist condition.

"The stronger preparations of alcohol possess no advantage over 60 to 70 per cent preparations, even when the bacteria are moist; therefore, and since they are inert against dry bacteria, they should not be employed at all as a means of securing an aseptic condition of the skin."

Bichloride of mercury is the most widely used substance in skin disinfection. This salt, while a powerful germicide under test-tube conditions, is rendered inert by organic matter, such as pus, serum, blood, soap, skin, mucous membrane, albuminous fluids, etc. The insoluble albuminate of mercury is formed, and the salt neutralized, after which there is no germicidal action. The use of this salt is illusory and deceptive and, as a skin disinfectant, its results are inconstant and uncertain. Bacteriological control of bichloride hand disinfection may give negative results, because the antiseptic or inhibiting action is great, so that cultures taken do not grow because of the surplus sublimate, or, if the salt is neutralized, the neutralizing agent may itself inhibit growth.

For this reason, negative results of cultures after disinfection with mercuric chloride are of little value. However, positive results of growth of bacteria from the skin after treatment with mercuric chloride are very frequently reported. Geppert, for example, grew cultures after a fifteen-minute application of 1:1000 mercuric chloride. Aperlo found that 2 per cent bichloride of mercury solution had no effect upon the number of germs on the hands when the antiseptic or inhibiting action was eliminated, and Fowler showed that bichloride lost its efficiency in the presence of pus. Further adverse reports could be cited indefinitely.

The other mercury salts are equally impracticable. Harrington of Boston, for example, examined mercuric cyanide and found that 1:500 solution had no effect upon staphylococcus aureus up to half an hour, beyond which time the experiments were not continued.

Iodine solutions are also impracticable for hand disinfection because of the irritation to the skin which they cause. Alcoholic solutions of iodine give only superficial disinfection, while with solutions of iodine in fat solvents, such as carbon tetrachloride or acetone, there is complete penetration of the entire cutis, as has been shown by my own carbon tetrachloride 2 per cent iodine solution. Loiacono, who studied the subject thoroughly, concluded that tincture of iodine would not kill organisms while on the skin, and that disinfection of the normal skin by tincture of iodine was impossible. Robb came to a similar conclusion that tincture of iodine was not to be relied upon, and that, after the removal of the iodine from the skin, organisms were frequently found.

Potassium permanganate and oxalic acid have the objection that their effect is diminished by organic matter, such as soap, skin, albuminoids, serum, pus, blood, etc. The same is true of formalin, which has a carbolic acid coefficient of only 0.3, so weak as to be negligible for disinfection of any kind.

Mechanical washing has but little effect upon the presence of bacteria on the hands. In this study they were always found after five minutes scrubbing with soap and water. This is not surprising, as soap has no germicidal value. Aperlo concluded that continued washing up to one hour had no effect upon the presence of skin bacteria. Five minutes satisfied me, as beyond that time the irritation to the skin was so great as to exclude this method on practical grounds.

The experiments of Schumburg showed that, when the old method of cleansing the hands by scrubbing with soap and water was used, the hands often showed more bacteria after scrubbing than before, and that washing the hands with a nailbrush and soap and hot sterilized water, even if carried out energetically for twenty minutes, does not remove the microbes which adhere to the skin. Soap appears to soften the skin as well as the

capsules of the bacteria, so that the latter adhere with unusual tenacity. He ascribes the lack of success of the scrubbing to the bringing of bacteria from the gland crypts to the surface. He showed that the subsequent scrubbing in bichloride solution did no good and only roughened the skin.

Van Brunn, in his experiments, found that preliminary washing with soap and water was undesirable and claimed that it interfered with subsequent disinfective action because of the swelling of the tissues of the skin, destruction of the skin ducts and hair follicles, and hydration of the tissue.

The ideal skin germicide should perform its work quickly and without irritation to the skin. It must be a fat solvent in order that the fatty content of the skin may be dissolved away and the germicide penetrate into the interstices, hair follicles, and sweat glands. More bacteria are in the hair follicles than elsewhere. No irritation should be caused, for, with continued use, irritation means inflammation and infection of the skin, rendering further disinfection difficult. The germicidal solution should be cheap and easily made. Last of all, it must be efficient and sterilize the skin within five minutes, as beyond that too much time is occupied in the process. If a method of disinfection is difficult and tedious, surgeons and assistants will unconsciously shorten the time. When a patient is ready, under ether, it is difficult even for the most self-controlled not to unconsciously hasten the time of immersion in the germicidal solution. For these reasons five minutes is the longest period allowable for the ideal skin germicide.

In making experiments in hand disinfection certain precautions should be taken in order to have a true and honest result. The hands should be infected or contaminated before each experiment with a twenty-four-hour culture of one of the pus-forming organisms, preferably staphylococcus aureus. This culture should, in each case, be allowed to dry into the skin and penetrate by rubbing into every crevice. Cultures older than twenty-four hours have a reduced resistance, which may amount to one-third of the normal resistance of a young, vigorous culture. Hence the need of standardizing the resistance of the culture.

After the germicidal solution has been applied, all antiseptic action, inhibiting culture growth, must be eliminated or removed, either by washing or by neutralization. The wash or rinsing water should also be tested by plating to find whether any inhibiting action remains after inoculation with some of the culture. Streak cultures on agar plates give more exact results than do shake cultures, and less outside or accidental contamination, although both methods should be used. The scrapings, taken from the hands, should be obtained by a knife, exerting firm pressure in order to get as much of the superficial skin as possible, and scrapings should also be taken from under the nails.

A review of a great number of papers upon hand disinfection did not reveal one in which all these precautions were taken. The present study was conducted according to these requirements, and, in addition, a control of the infected hands was made on each occasion in order to show that a vigorous culture was used. The hands were bathed and rubbed in twenty-four hour staphylococcus aureus broth culture. Bacillus prodigiosus was also used. The culture was allowed to dry upon the skin. A control plate was made from the scrapings before disinfection, and invariably showed from 20,000 colonies to profuse overgrowth impossible to estimate. The hands were then immersed in the solution, one hand only in each vessel, in order that there might be no marked mechanical action to mask the result. The hand was then removed and the excess of solution allowed to drain off from the skin. The hand was then thoroughly rinsed in sterile water until all traces of the germicide were removed. Five ccm. of culture were added to each litre of the first rinsing water, and 1 ccm. plated to show that there was no inhibitive action. Scrapings were then taken by firm pressure from the skin, and beneath the nails, and plated on agar.

During a period of ten years many hundred solutions and germicides have been tried and compared one with another as to results. This comparison was obtained by shortening

the period of immersion to 15 and 30 seconds in order to find the breaking point of the solution. My final solution had the following composition:

Acetone[1] (commercial)	40 parts
Denatured alcohol	60 parts
Pyxol	2 parts

With this solution, in no case was any growth obtained after 30 seconds' immersion. This period, however, is too short in practice, and one minute is advised to provide a margin of safety. Preliminary washing with soap and water was found to be no aid to efficiency, but was rather a slight hindrance. It had no additional disadvantage of irritating the hands. No growth was obtained in a number of experiments when the hands were simply sponged with the solution (one-half inch deep) for one minute and not immersed. This sponging was considered only as an emergency method in case of great haste and scarcity of solution.

The method advised is to treat the hands in the germicidal solution in a vessel sufficiently large to admit the hands and rub with a nail-brush for the nails, and a gauze cloth for the arms, to aid the solution in permeating every crevice. As has been said, the experiments were conducted with very little or no mechanical friction or rubbing, in order to make doubly sure of the value of the final solution; but, in practice, this is recommended as an additional precaution.

In order to eliminate, as much as possible, the personal equation, all cultures from the hands were controlled by Dr. Frederic Sondern, who confirmed the results in all particulars.

This solution has the following advantages:

It is reasonably cheap. It does not irritate the skin, as I have proved by many thousand immersions of my hands and arms. It contains a fat solvent, acetone, which causes the solution to penetrate. The alcohol is a good vehicle. It contains a strong germicide, twenty times as germicidal as carbolic acid in equal strengths, and this germicidal value is not impaired by the alcohol or acetone. This was proved by taking the coefficient of the pyxol after it was in solution in alcohol and acetone.

The solution thus has the germicidal value of phenol in 40 per cent solution (if such a solution could be made), plus the germicidal action of the solvent. Pyxol is a dark liquid, extracted from coal-tar creosote, which forms a white emulsion with water, and a light mahogany-colored solution with alcohol and acetone. Its germicidal efficiency is twenty times that of phenol. The action of pyxol is not impaired by pus, soap, serum, and other albuminous matter. Pyxol is said to have the following composition: 40 per cent pyxol oil, 30 per cent neutral hydrocarbon oil, and 30 per cent saponified vegetable oil. It is said to be free from carbolic and cresylic acid. The neutral vegetable oils are present only as emulsifying agents.

In conclusion, it is to be advised that the hands be disinfected before operation by immersion in this solution for one minute with the aid of a nail-brush and a gauze cloth. By this means more complete disinfection may be obtained than by any of the known methods. The solution is inexpensive, unirritating to the skin, and efficient. It may be used repeatedly. It will acquire a sediment of various detritus which in no way impairs its efficiency.

I wish to thank Dr. Frederic Sondern for his care and usual thoroughness in the final bacteriological work in controlling my results, which were first worked out in my own laboratory. His report is appended and shows that the period of immersion was seldom extended beyond half a minute, although one minute's application is advised in order to provide a margin of safety.

This solution has been used by me for the sterilization of the hands and the sterilization of the skin of the abdomen before operation for more than a year with uniformly satisfactory results. In the sterilization of the skin of the abdomen, it is rubbed on for two minutes before operation after the patient is under ether without any preliminary washing. It speedily evaporates from the skin.

Since using this solution, I have had better wounds with more perfect healing than ever

[1] Acetone may be best obtained from dealers in painters' supplies. It is used by them as a varnish remover. It need not be chemically pure.

before, and the same report has come to me from other surgeons who have used it in their practices for sterilizing the abdominal skin.

Since it is possible to sterilize the hands so thoroughly and in such a quick and easy fashion, it does not seem to be any further advantage in using rubber gloves, for the hands can be resterilized after contamination in less time than it takes to remove the contaminating gloves and put on a clean pair. Since I have been convinced of the efficacy of this method of sterilization of the skin of the hands, I have not used gloves while operating. I have, however, fortified my skin by means of a hand varnish which is very easily applied and which I have described in another journal.[1]

LABORATORY REPORT

BY FREDERIC E. SONDERN, M.D.

TESTS OF EFFICIENCY OF FLUIDS FOR HAND DISINFECTION

Report No. 50,755. October 27, 1913.

Technique. The hands were bathed in staphylococcus aureus 24-hour-broth culture, and the culture allowed to dry in. On removal from fluid the hands were well rinsed in sterile water and scrapings taken by firm pressure with a knife from the palm and fingers. An agar plate was made. This technique was repeated for each experiment.

Solution B=

Alcohol	60 parts
Acetone	40 parts
Pyxol	2 parts

Plate No. 4. Unwashed hands in solution B for 30 seconds; no growth.

Plate No. 6. Unwashed hands in solution B for 1 minute; no growth.

Plate No. 8. Unwashed hands, nail scrapings, in solution B for 2 minutes; no growth.

Report No. 50,809. October 29, 1913.

Plate No. 2. Hands washed in water and soap 5 minutes with addition of 1 minute in solution B; no growth.

Plate No. 4. No washing, 15 seconds in solution B; no growth.

Plate No. 6. No washing, 30 seconds in solution B; no growth.

Plate No. 8. No washing, 30 seconds in solution B; no growth.

Report No. 50,934. November 3, 1913.

Hands infected with bacillus prodigiosus; no preliminary washing before treatment.

Plate No. 1.[2] 30 seconds in solution B; one contaminating colony, no prodigiosus.

Plate No. 2. 30 seconds in solution B; no growth.

Plate No. 3. 30 seconds in solution B; no growth.

Plate No. 4. 30 seconds in solution B; no growth.

Plate No. 5. 30 seconds in solution B; no growth.

Hands infected as above, then rinsed and sweated in rubber gloves for 15 minutes.

Plate No. 6. 2 minutes in solution B; no growth.

Plate No. 7.[2] 2 minutes in solution B; one contaminating colony, no prodigiosus.

Hands infected as above; no preliminary washing before treatment.

Plate No. 9. 15 seconds in solution B; one colony staphylococcus albus, no prodigiosus.

Plate No. 11. 30 seconds in solution B; no growth.

Plate No. 12. 15 seconds in solution B after preliminary soap and water scrubbing 5 minutes; no growth.

Plate No. 13. 15 seconds in solution B after preliminary soap and water scrubbing 5 minutes; no growth.

Plate No. 14. Sponging in 10 ounces solution B, 1 minute (fluid in basin only ½ inch deep); no growth.

Plate No. 15. Sponging in 10 ounces solution B, 1 minute (fluid in basin only ½ inch deep); no growth.

NOTE.—In certain coal-tar creosotes there is a highly germicidal substance which is used as the essential germicide in three different preparations. It has never, to my knowledge, been isolated in pure form as yet, and its composition is unknown. It is present in the germicide used here in an impure form, and it is hoped that it will be eventually isolated.

The germicide here used and the solutions I have devised should be used with caution upon the mucous membrane and on raw surfaces. It is irritating to them, although not irritating to the unbroken skin.

[1] Ellice McDonald. A new skin varnish and substitute for rubber gloves. Med. Rec., 1914, March 21.

[2] Contaminating colonies in Nos. 1 and 7 on edge of plate and obviously technical error or dust.

REPORT ON SKIN DISINFECTION BY McDONALD'S SOLUTION

By C. G. McMULLEN, M.D., F.A.C.S., Schenectady, New York
Gynecologist to the Ellis Hospital

THE prevention of infection has always been the endeavor of surgeons, and complete elimination of bacterial infection is their ideal. Many and various are the methods which have been devised of this nature, and great are the improvements that have been made. Sterilization of dressings and instruments by heat is one of the greatest advances, and the chief remaining source of infection which may possibly be avoided is contamination from the abdominal skin and the surgeon's hands.

Rubber gloves have been a great improvement, although in the last few years there has been a tendency to cast some doubt upon their complete efficiency. Gloves are frequently torn or pricked by needles to liberate bacteria suspended in the perspiration of the hand. Unless the hand is sterile when inserted into the rubber glove, the moisture and perspiration from the hand will collect within the rubber and very soon be contaminated by the bacteria of the skin. Hellendall and Fromme[1] found that in 46 of 90 operations the gloves of the surgeons after operation contained liquid sometimes to the amount of several cubic centimeters. This liquid, as was shown by cultures, contained two, three, and even ten times the number of organisms recoverable from the hand before the glove was put on, and in some cases more than before the hand was treated. Putting on gloves dry did not alter the result. This is a commentary upon the danger of glove punctures and the inefficiency of former methods of hand disinfection.

Gloves themselves are difficult to sterilize and require fifteen minutes in boiling water, or one hour in the steam sterilizer with fifteen pounds' pressure. Braun[2] found that, when tightly wrapped, gloves require one hour's steam sterilization; three-quarters of an hour did not suffice unless the gloves were loosely wrapped and the fingers distended by cotton. His results were controlled bacteriologically. He favors placing cotton gloves inside the rubber in order that the steam may penetrate. For this reason it is best that if gloves are used they should be boiled and not sterilized in a steam sterilizer.

An example of the pessimism which exists in regard to skin disinfection is shown by bacteriological tests of Hecht and Koehler,[3] who state that ideal asepsis of the hand does not exist, and that all methods heretofore devised effected at most a diminution of the number of bacteria or a reduction of those liberated, but never a sterile condition of the hand. They stated that tincture of iodine is not germicidal, but tans the skin and that the sterilized rubber gloves furnish an aseptic covering to the hand at the beginning of operation only. Aperlo,[4] in a study of disinfection of the hands, came to the conclusion that continued washing with warm water and soap and using a sterile nail-brush was not sufficient to remove the germs from the skin and that the result, was no better if the washing was continued for one hour. washing the hands with a 2 per cent bichloride of mercury solution had no effect upon the number of germs on the skin. It is very easy to contaminate a boiled rubber glove when putting it on by touching the outside with the imperfectly sterilized skin of the hand.

There is no doubt that, heretofore, abdominal operations have usually been done through skin that was imperfectly sterilized. Steinegger[5] studied the bacteriology of the treated skin by making cultures with the knife which was used to make the skin incision. The skin was disinfected by the methods in common use at present—alcohol, iodine solutions, etc. In 347 observations in cultures obtained from the knife, in 72 instances, and it is probable that in a number of

[1] Hellendall and Fromme. Zentralbl. f. Gynäk., 1912, November 30.
[2] Braun. Beitr. z. klin. Chir., 1908, lxviii, 2.
[3] Hecht and Koehler. Wien. med. Wchnschr., 1911, xi.
[4] Aperlo. Klin. Chir., 1913, xxi, 321.
[5] Steinegger. Ztschr. f. Chir., 1913, May.

cases in which no growth was obtained, the bacteriological growth was due to the inhibition from the antiseptic action of the solution used in disinfecting the skin. The majority of these cases were treated by iodine skin disinfection.

Being dissatisfied with my methods of sterilization of the abdominal skin and hands before operation, I was interested in the investigations of Dr. Ellice McDonald upon the various methods of skin disinfection. In June, 1914, I began using his solution. Previous to this time I had used iodine skin disinfection. McDonald's solution is as follows:

Acetone, commercial	40 parts
Denatured alcohol	60 parts
Pyxol	2 parts

The field of operation was prepared, if possible, on the evening before the operation, by shaving and washing with green soap, water, and alcohol. It was covered with a dry sterile towel and left until the next day. At operation, the site was treated by rubbing with McDonald's solution for about two minutes. The hands of the assistants and operator were prepared by scrubbing with soap, water, and alcohol, followed by two minutes' treatment with McDonald's solution.

Over a period of eight months I operated upon 276 major cases which had been prepared after this method. They were practically all laparotomies or hernias. In emergency cases the soap and water scrubbing of the operative field was dispensed with and only McDonald's solution used. In this series of cases there were seven skin infections, a percentage of 2.54 per cent. These cases were as follows:

1. Clean appendectomy, which had a very slight or mild skin infection.

2. Inguinal hernia. The infection was found sixteen days after operation and the pulse and temperature were normal in the meantime. The infection was apparently due to some irritation from the kangaroo tendon suture.

3. Abdominal hysterectomy. Skin infection.

4. Bilateral purulent salpingitis. Infection of the space of Retzius occurred and was apparently due to spreading of the infection from the pus tubes themselves.

5. Cæsarean section. A skin infection. This was a contaminated case, as the cervix had been packed with gauze 48 hours before operation.

6 and 7. Clean laparotomies. These were done at the Mercy Hospital on the same day, and it was subsequently demonstrated that several of the operating room nurses were suffering from sore throats. The organism in the wound infection was identical with the organism cultivated from the throats of the nurses. The wounds in the service of other surgeons suffered in the same way.

Excluding those cases in which infection was obviously due to some extraneous causes, there remain but three cases in which there was any skin infection, which might be attributed to improper disinfection of the skin. It is, however, a well-known fact that in both hernias and abdominal hysterectomies infection is more frequent than in other clean cases, so that these three cases can hardly be charged against McDonald's method of skin disinfection.

From this analysis of my experience with this solution I believe it to be the most efficient method of skin disinfection at our disposal at the present time. Healing, under its use, seems to take place more readily than under the iodine skin disinfection. Previous to this solution, tincture of iodine was used over a period of a number of years, and since the change in method there has been noted a definite change in the manner of healing. Wound repair is accelerated by at least three days; that is to say, wounds in skin treated by McDonald's solution and dressed upon the tenth day have the appearance of wounds three days older under the iodine skin disinfection. I consider that the new solution very decidedly reduces the risks of contamination and infection of the wound from skin organisms. Applied to the hand, it is unirritating and is almost ideal as a skin disinfectant.

NOTE.—Being so well satisfied that this method of skin disinfection eliminates bacterial contamination from the hands of the operator, I have been encouraged to use McDonald's skin varnish and substitute for rubber Gloves (McDonald, *Medical Record*, 1914, March 21). My assistants wore rubber gloves and I myself used the skin varnish and had very satisfactory results. During the cold weather, however, I found that the acetone used in its removal caused a little irritation of the skin. However, it has been suggested to me that this might be obviated by using the germicidal solution to remove the skin varnish. I intend to return to the use of the skin varnish instead of rubber gloves, for the increased tactile perception is a very great help in operating on deep-seated abdominal lesions.

STERILIZATION OF THE SKIN BY A MORE POWERFUL AND LESS IRRITATING GERMICIDAL SOLUTION THAN TINCTURE OF IODINE

By E. MacD. STANTON, M.D., F.A.C.S., Schenectady, New York

STERILIZATION of the skin is still a subject for debate. Any changes in the technique of skin disinfection must fulfill certain demands. The future method of skin sterilization must not only give better results than are obtained by the iodine method but must be equally rapid and simple in its manner of application. This necessitates reliance upon some germicidal solution, and it is generally conceded that the ideal solution should fulfill the following conditions:

It must have a high degree of bactericidal activity. It should be generally applicable on all skin surfaces wet or dry, including the hands of the operator. It must be capable of penetrating the crevices of the skin and dissolving oily substances in the skin to reach buried bacteria. It must be non-irritating and at the same time it should not lower the power of resistance of the tissues, nor by its presence delay the processes of wound repair.

It has been abundantly demonstrated by those who have investigated the question bacteriologically that tincture of iodine is not an ideal germicidal solution for skin disinfection. Under favorable conditions, with direct contact with the bacteria, iodine is a moderately active germicide, but upon the skin, conditions are unfavorable. The penetration of iodine is apparent rather than real, and in several other respects tincture of iodine fails to meet the requirements. Since Grossich[1] demonstrated that results equal to the more complicated methods of skin disinfection could be obtained by painting the dry skin with tincture of iodine, the iodine method in some of its modifications has been adopted by most surgeons here and abroad. However, experiments of Robb[2] showed that, when the inhibitive power of the excess of iodine had been removed by washing with 10 per cent potassium iodide, bacteria were almost constantly recovered in culture after tincture of iodine disinfection. The effect of the inhibiting power of tincture of iodine is shown in the fact that when this precaution is not taken in making cultures, the cultures were sterile in 86 per cent of the cases, but when the excess was neutralized by potassium iodide solution, organisms were very frequently found. He concluded that sterilization with tincture of iodine is not efficient and should be used only when more elaborate forms of disinfection are contraindicated. Similar results have been reported by Loiacono,[3] Tinker and Prince,[4] and others. A dry field is essential to its success. This was amply demonstrated by Grossich, Walther, and Touraine,[5] and many others and necessitates either washing and shaving the field some hours before the operation, or a dry shave, the irritation of which every man knows. Furthermore, tincture of iodine is too irritating to be a hand disinfectant, and thus is not universally applicable in the operating room. Heusner[6] added a fat solvent in his 1:1000 iodine-benzine solution, but this merely complicates the treatment and this iodine-benzine solution may blister dependent or moist surfaces.

The use of tincture of iodine as a therapeutic irritant long preceded its use as a germicide, and while the irritation produced does not condemn it as a skin disinfectant, it is nevertheless a disadvantage. The possibility of the iodine used on the skin coming in contact with exposed peritoneal surfaces and causing troublesome irritation is recognized by many surgeons, and the field of operation is therefore encumbered and ob-

[1] Grossich. Zentralbl. f. Chir., 1908, No. 44, 1286.

[2] Robb. Surg., Gynec. & Obst., 1913, xvii, 324.

[3] Loiacono. Gynecol. mod., 1909, September.

[4] Tinker, M. B., and Prince, H. L. Common fallacies regarding skin disinfection, with special reference to the iodine methods. Surg., Gynec. & Obst., 1911, xii, 530.

[5] Walther and Touraine. Bull. et mém. soc. de chir., Par., 1909, xxxv, 345, 394.

[6] Heusner. Zentralbl. f. Chir., 1906, September.

scured by protecting pads and towels partially held in place by all sorts of specially devised clamps. Bloodgood[1] has shown that in the presence of bichloride of mercury, iodine may become a very irritating and blistering substance.

In two and one-half years' use of the benzine-iodine-tincture-of-iodine method of skin preparation in my own cases, very acceptable results were obtained as to infection, but in about one-fifth of the wounds there was an appearance of delayed healing, due to the chemical effect upon the tissues.

During my interne service at St. Mary's Hospital, Chicago, iodine on a wet surface was usually freely used by all surgeons. The results were good, yet the occasional case which escaped the tincture of iodine healed more rapidly than did the iodine-treated cases. Later, at the Augustana Hospital, I saw large series of operations performed after a simple soap-and-water scrubbing the night before and a rinsing with alcohol immediately before the operation. This simple preparation gave the best results both as regards freedom from infection and rapidity of primary healing, except the recent alcohol-acetone-pyxol-prepared cases. Later a more elaborate and painstaking preparation showed few skin infections, but caused delay of wound healing, so that a twelve-day wound after the complicated method looked approximately like an eight or nine day soap-and-water-alcohol wound. This delay in healing was at once eliminated when the method of preparation was chemically simplified. My conviction is that wounds through iodine-prepared skin surfaces are more œdematous and slower in healing than clean wounds made through skin surfaces prepared with simple soap and water or alcohol scrubbing.

Since November 1913, I have used Dr. Ellice McDonald's solution as given in his paper:

Alcohol (denatured)	60 parts
Commercial acetone	40 parts
Pyxol	2 parts

The solution is non-irritating, so that it can be regularly employed for disinfecting the surgeon's hands as well as the patient's skin. Water, up to 10 per cent or more, does not interfere with its action. Hence it is possible to use it on wet skin surfaces, such as those recently lathered for shaving, or the operator's hands after he has scrubbed them with soap and water.

The solution is itself an excellent cleansing medium and so harmless that it can be used actually to scrub the patient, whereas tincture of iodine should not be rubbed in. It can be used before the patient is anæsthetized without danger of complaint, as it is not irritating. It does not stain skin surfaces and dries very quickly, so that it is not necessary to protect peritoneal surfaces from contact with the skin, as in the case of iodine skin treatment. It is cheaper than tincture of iodine.

During the fifteen months in which I have used this solution I have had only two infections occurring in 240 otherwise clean cases, a record never before equalled in my own work. Both of the infections were studied bacteriologically and traced to their sources. The first one in December, 1913, was one of a group of similar infections occurring in the work of several surgeons in the same hospital, and was definitely traced to an operating room error in catgut preparation. The second one occurred in January, 1915. Three other surgical infections occurred in the same hospital at this time and within two days, and it was found that half the nurses in training had septic sore throats. These infections were apparently due to this cause.

During the year 1914 there was not one drop of pus collected in a clean case operated upon by me. Such results are significant and at least show that the method of skin preparation was efficient. Even more important is the fact that the wound healing was without evidences of chemical irritation, without peeling or blistering of the skin, and quite as rapid as that previously observed in simple alcohol-prepared incisions. In conclusion, I would say that I have never before had such rapid healing free from all evidence of chemical irritation.

[1] Bloodgood. Progressive Med., 1913, xv, 4, 225.

CYSTALGIA; URETHRALGIA

Syndrome Vesical and Urethral Neuralgia

By LEON JOSEPH ROTH, M.D., F.A.C.S., Los Angeles

THIS syndrome with its more or less complicated etiology has to a certain degree escaped definite description. The condition is sufficiently often met with to make it a subject of more than passing interest, and the aim of this paper will be toward simplifying its symptomatology and classifying its causes.

The primary division of these cases, as regards the etiology, is into the idiopathic and symptomatic. For the purpose of differential description this latter will be subdivided into—

1. Lesions involving the nervous system.
2. Lesions of the urinary tract.
3. Lesions of adjacent structures.

1. *Lesions of the nervous system.* Of all the diseases included in this category, tabes most prominently presents urinary derangements. In practically all forms of paralysis, retention is the chief urinary symptom. Tabes is not an exception, but it may present apart from this a more or less typical cystalgia. This is sometimes the revealing symptom of a posterior sclerosis. In neither the pre-ataxic stage nor in confirmed tabes are the symptoms constant or progressive; they may be attenuated or may disappear entirely in spite of medullary progress, and *vice versa*. The tenesmus accompanies urination, occurs during the evacuation of the last few drops, or may persist for a varying time with total inability to void any urine whatever; it manifests itself at the cervix and along the urethra with irradiations to the rectum.

The "vesical colic" or crisis, as first described by Fournier, are pains of sudden apparition, which extend over the bladder, urethra, and perineum, and are atrocious in character. They persist from a few minutes to half an hour, and disappear brusquely. During this crisis the desire to urinate is exaggerated, and the act is imperative and irresistible. The patient passes urine with difficulty and with tearing pains at the bladder neck.

Hysteria is responsible for a train of symptoms of which pain and spasm of the urethra with possible transitory retention are the major manifestations. Very large quantities of low gravity limpid urine are voided and the attack disappears for an indefinite time.

2. *Lesions of the urinary tract.* This class includes a majority of the surgical infections of the urinary system. Dilatation upon all these factors will not be attempted, because in the severer surgical complications the vesical symptoms are not classically those of a neuralgia but assume the type of an ordinary cystitis, or of dysuria with severely infected bladders; that is, the "painful cystitis" of Hartmann. The various forms of renal reflexes described by Guyon and others play an important rôle, and it may be assumed that these are the primary causative elements of the vesical pain and that their creation is due to inflammation and obstruction of the upper urinary segment and the production of pelvic retention and distention. The commonest conditions imputable are urinary tumors, movable kidneys, ureteral strictures, and calculi. Occasionally a painful nephritis transmits sensation to the bladder muscle. The ingestion of such drugs as turpentine, cantharides, and the balsamics are provocative; the latter particularly causes severe renal colic that may be transmitted downward.

Foreign objects in a non-infected or mildly infected bladder have been observed; for instance, a button, hairpin, piece of wood, or calculus. The attendant symptoms were dysuric but did not assume the aggravated type of true neuralgia.

3. *Lesions of adjacent structures.* Affections of adjacent structures, such as abdominal and pelvic tumors and masses, determine vesical spasm in a certain proportion of cases.

Pressure, adhesions, inflammation, or post-operative nerve inclusions may be invoked as the causative influence. The pregnant uterus is here included. Uterine deviations are frequently the source of cystalgia, particularly the anteflexions and versions, while ulcerations and adhesions of the cervix, particularly the latter, add bladder misery to the sufferings of neurotic young women.

The remnants of a prostatitis and vesiculitis, although they be subjectively painless, may, however, give rise to cystalgic symptoms. In plural examinations of these patients who are sexual and urinary neurotics, the fact is noted that the exploring finger will determine exquisite pain upon pressure, but the pain is rarely ever in the same place. The verumontanum is a prolific source of trouble, and very amenable to treatment. A spasmodic prostatic urethra, and, in the more aged, a fibrosis, are conditions that present occasionally. In two cases of prostatic carcinoma the dominant symptoms were sciatic pains and severe cystalgia. Both bladders were infected. In one the pain would disappear for days at a time. In the other the urinations occurred at about two-hour intervals, sometimes painless, but more frequently accompanied by terrific spasm. This case was complicated by large multiple calculi.

In this latter class of cases the fault is pathologic in an anatomophysiologic sense, the cervix being rigid, or at least its mobility is reduced, and there is no normal descent of this segment accompanying the excursion of the vault; in consequence the bladder reaches its containing limit sooner than it should. Thus the frequency is increased, plus the generation of more or less classical symptoms.

The voluntary continents—that is, the pre-nuptial paragon and the sexual hypochondriac—present similar modified urinary symptoms resulting from the congestion caused by repeated erections. As a rule the posterior urethra is the vulnerable part, and while the urinations may be burning in character and slightly more frequent than normal, they do not attain the strict type of a neuralgia. From time to time a case is seen with these symptoms plus transmitted pain to the testicles and the Cowperian region.

In male children congenital stricture of the meatus and phimosis are exceptionally included in this description.

Of frequent occurrence are rectal and anal ulcerations and growths. Omission must not be made of hæmorrhoids and fæcal or gaseous distention of the rectum. Eversion of the anal mucous membrane has produced a most intense cystalgia.

In a general way may be mentioned gonorrhœa or other microbic infection of the urinary or genital tracts, and especially gonorrhœa of the lower bowel.

One of the most important and most commonly encountered conditions determining bladder spasm is an atresia of the female urethra and vagina. It is either of hysterical origin, or, oftener, is produced by senile sclerosis and atrophy of the respective sphincters with the attendant changes in the mucous membranes.

To recapitulate, the actual conditions existing in the majority of cases are of pelvic or contiguous origin, and of these the reduction into vesical, urethral, vaginal, and rectal subdivisions greatly simplifies the classification and produces a substantial working basis.

Idiopathic. The more experience I have the more I am convinced that idiopathic conditions do not obtain and that by careful examination some lesion in the urogenital apparatus or anorectal structures will be found. My belief is that where no lesions can be found after thorough investigation a preëxisting trouble has healed spontaneously or has been cured, and that the remnant is a neurosis dependent upon the impression received by the pelvic or genital nerves, the intricate association of the motor, sensory, and sympathetic filaments being so well known that here further dilation is unnecessary.

A word on the physiology and psychology of urination: Normal urination is accomplished by the action of two diametrically opposing forces. The first is dynamic and is a portion of a reflex arc, that may have as its origin the muscular sense of the bladder or the cerebral idea of micturition, and has as

a result the contraction of the bladder. The second, on the contrary, is purely psychic and requires the temporary suspension of the voluntary action of the external sphincter. This is best realized by absolute mental distraction. If this distraction is not total the micturition is dribbling, deformed, difficult, interrupted, or impossible. Normally, the desire to urinate is induced by vesical distention and the act should not be produced until the bladder content reaches its physiologic limit. This is customarily impossible, and therefore the individual creates his own urinary habits, which permit the brain to control the sphincter. The mental condition then makes instinct subservient, and a subject worried by urinary preoccupation has his attention always attracted to the bladder. This results in pollakiuria, and the ultimate condition is a metamorphosis from a urinary neurotic to a psychopathic dysuric. Consequent upon this the bladder entertains a state of permanent irritability.

Symptomatology. Adults, women especially, between the ages of 40 and 60 are those usually attacked. They may otherwise appear in perfect health. In a second category are young women, whose general conditions are perfectly normal, but in this class, like the previous one, they are all manifestly neurotic, and the neurosis varies from a mild exhibition to a paranoic approach. To illustrate, in a case with which I am familiar the patient would have her attacks timed by the clock twice daily and indulge in pitiful paroxysms. If the hands of the clock were set forward or back the patient would have her cystalgic crisis at the scheduled hour. The balance of the day and night was spent in comparative comfort so far as the bladder was concerned. Following a practically painless cystoscopic examination, in another case, the woman sat staring into space, her hands firmly clasped, and if any one addressed her she would cry and moan. This lasted for three hours, the patient and her pain finally leaving when she was informed that the meter of a taxicab had been at work for a half-hour.

In practically all cases the patients are unable to state a definite cause. The attack has come on quite suddenly, progresses rapidly to its height, and continues chronically for several months with remissions. The interval between attacks has in some of my cases been a year or longer. Several recurrences are noted in nearly all histories. At their first examination the patients have mostly all had the same diagnosis made — that of cystitis — and practically all have been given the same treatment, consisting of morphine hypodermatically and frequent vesical irrigations. As a rule no benefit follows; in fact, there occurs an increase in intensity of the suffering, most probably on account of the repeated distentions of the bladder, and the fact that the patient's attention is more attracted to those parts by recurrent interferences. In most cases the patients urinate more frequently during the day than at night, though the reversed condition may be seen, also the combination of nocturnal and diurnal frequencies. If the noctural variety obtains, the paroxysms begin usually at the same hour, and persist for intervals varying from one-half to one hour, and do not subside until early in the morning. During the day the frequency depends upon the amount of distraction. The number of spasmodically painful urinations are in large number if the patient is at home; the intervals may extend to three or four hours if the patient is on the street or shopping. A curious fact exists that as a class these subjects are very intelligent, refined, and well preserved, calm as to outward appearances and martyrs on account of their pain. Some tell of their spasms, moved by emotion, and relate that the births of their children were mild in comparison.

The pain is analogous to that of cystitis. The bladder and urethra either singly or combined become spasmodic and the contraction of the urethra may produce a state of retention with intolerable suffering. The pains occur with the bladder in any stage of repletion, and are referred to the urethra, glans, testicles, rectum, labia, or the lower vertebral region. These continue during the entire period of urination and may persist for a time following it. At this epoch the spasm may become clonic, and the rapidly opening and closing sphincter, expelling

successively a few drops of urine, add agony to the already pain-racked individual.

Relief is secured for a certain interval, only to be dispelled by a recurrence of the tenesmus as soon as the exciting quantity of urine re-accumulates. In some cases the urinations are almost continuous. A succession of spasms occur, the patient voiding only a few drops of scalding fluid.

The appearance of the urine is for the most part limpid. Pus may be found in varying quantity. Suppurative affections of the upper urinary tract and of the bladder naturally increase the amount, but this has nothing to do with the urethrocystalgia as an entity. If cystitis in any form occurs it is usually possible to differentiate. It must be remembered that we are attempting to describe an affection for the most part free from infection and trying to avoid a too complicated description by excluding large suppurative processes. A small amount of pus of trigonal and cervical origin is accepted; this is not the cause of the trouble, but the result of it, and is produced by the hyperaction of the sphincter and the resulting congestion. It is unusual that more than a few blood-cells are found. The cause is the same as previously mentioned; a greater quantity is significant. There is never the terminal hæmaturia, as it exists as a cardinal symptom of true cystitis. A cloudy sediment is occasionally produced in a specimen if allowed to stand for several hours; this cloud is composed of mucus and epithelial cells, some pus-cells, and urinary solids. Bacteriuria is very common; it is of the colon type. It is usual to find a few microörganisms, though a urine containing myriads of them is not rare. This is simply a complication and has no direct influence upon the cystalgia.

A preliminary examination may disclose no etiological evidence. Occasionally a polyp, caruncle, or psuedocaruncle of the meatus or its vicinity is present; these have often been discovered by the patients or they have been informed of their presence during a previous examination. Much importance is attached to this, justly so in some cases; there are others in which the growth has been cut or destroyed by caustics or cautery and no amelioration occurs. Of particular importance in many instances is the appearance of the external vaginal mucous membrane and that covering the urethra and its meatus. It assumes the ordinary characteristics of senile membranes, and discloses a sclerotic change, not only superficially, but in the sphincters underneath; and this change is more responsible for the urethrocystalgia in a certain category than any other cause; if evidenced by no other reason than that upon the passage of a catheter, sound, or cystoscope (and sometimes gradually increasing dilatation is necessary or the use of a considerable amount of force), the patient experiences a vast amount of relief, particularly during the entire following night; of course the symptoms return later, but the patients' spirits are improved and they see a ray of hope. It is appropriate at this time to suggest that too frequent dilatation will prove fatal to anticipated permanent relief. In some of these cases there is a decided vaginal orificial atresia, the introduction of one finger being all the patient can stand on account of the pain produced. The urethra is felt as a hard, resilient cord, and the meatus is an inverted slit that resists to a marked degree the passage of an appropriate rounded blunt instrument. Upon the introduction of fluid into the bladder, inflammation of that viscus is excluded. The capacity varies, of course, but there is practically no painful sensation caused by contact of the fluid, and some bladders previously emptied every few minutes with characteristic spasm allow the introduction of from 150 to 200 ccm. before any sensation to distention is evidenced. It is wise at this juncture to allow the bladder to empty through the catheter into a glass and show the patient the actual vesical capacity. This is a part of the psychological treatment.

Cystoscopy is a matter of routine; and such patients as have a hypersensitive bladder (probably hysterical) are directed to insert a rectal opium suppository before leaving their homes and to drink several glassfuls of water; in this manner an examination may be made by the immediate introduction of the cystoscope. If this fails, the

exploration can be made at the hospital under ether, having previously administered a hypodermatic injection of morphine. The cystoscopy is followed by a urethroscopy, preferably with the Buerger instrument. An anal and rectal examination is very necessary, and may be done at this time.

I must confess that thus far I have not met with any extraordinary vesical evidence. There is always a congestive trigonitis and cervicitis, and the urethra frequently shows hæmorrhagic patches and granulations, with the presence of an occasional caruncle, papillary growth, or fissure. This latter is probably traumatic, and possibly produced by a too strenuous examination made previously. The vesical mucosa and musculosa is in keeping with the general senile changes. From time to time apparent deformities are noted, but these are produced by minus distention of the bladder. The body or cervix of the uterus may cause heavy projections at the summit, but these for the most part may be made to disappear by introducing more fluid into the bladder, if the uterine mass is not too enlarged or not much adherent.

In several cases with marked anterior colpocele nothing of importance was found save an extension of the congested area and moderate bladder deformity. In one a very tender cicatrix, the result of repair of a urethrovaginal fistula, was undoubtedly the cause of the urethralgia.

In the case of a male, aged 64, with perfectly limpid urine and absolutely no urethral or prostatic lesion, the urethrocystalgia followed closely upon a Whitehead operation in which the cutaneous flap was too short and produced a large ringlike prolapse of the anal mucous membrane. The patient had been bilaterally castrated but without favorable results.

My youngest patient, a perfectly healthy girl of 17, had no recurrence of her attacks after a single urethral dilatation with the cystoscope.

The treatment will not be considered further. It is evident that in each case a proper diagnosis must be made, and suitable therapy instituted, medically, surgically, and psychologically. The majority of these cases can be cured. The prognosis in some is not good, and there are a few in which treatment absolutely fails.

Deductions. My investigations have led me to believe that the condition is a neurosis of reflex origin, the exciting cause being continuous with the bladder or contiguous to it. The theory is founded upon the fact of the composite innervation of the bladder, urethra, anus, rectum, and uterus by the sacral and coccygeal branches with the pelvic sympathetics. That the bladder is not the primary cause is proved by the absence of cystoscopic and urinary findings, except as has been previously stated.

THE BULGARIAN BACILLUS IN THE TREATMENT OF CYSTITIS AND PYELITIS WITH ALKALINE URINE[1]

By FRANCIS R. HAGNER, M.D., F.A.C.S., Washington
Professor of Genito-Urinary Surgery, George Washington University; Attending Genito-Urinary Surgeon, Garfield Memorial and George Washington University Hospitals

At the meeting of the American Association of Genito-Urinary Surgeons in May, 1914, Dr. John R. Caulk of St. Louis read a paper entitled, "Incrusted Cystitis and the Use of the Bulgarian Bacillus in Its Cure."

In this very severe form of alkaline cystitis we were considered, to quote Unterburg, Lichtenstein, and others, to have been therapeutically helpless. Dr. Caulk's idea in using the bulgarian bacillus to combat the alkaline urine is a very important addition to the successful treatment of these distressing cases.

[1]Read before the Southern Surgical and Gynecological Association, Asheville, North Carolina, December, 1914.

Eight or ten years ago Young tried to cure alkaline cystitis by the implantation of the colon bacillus, hoping thereby to get an acid reaction by its growth in the urine. At the time Young was trying this I had an experience with a patient in whom the urine was markedly alkaline and cystoscopic examination showed a very contracted bladder ulcerated over its entire surface, with a deposition of phosphatic deposits over the ulcers. The proteus vulgaris was isolated from this case. Repeated attempts were made to inoculate the bladder with the colon bacillus; traumatism of the bladder-wall being made at its injection in the hope of getting a growth that might cause an acid urine and destroy the proteus infection. The bacillus proteus, being a very resistant organism, seemed to kill the colon bacillus, causing its disappearance almost immediately.

North in 1909 collected a large series of cases in which the bulgarian bacillus had been used. In a series of 300 cases he made mention of but two in which it was used in the bladder, and these were indefinite reports; so I feel sure that Dr. Caulk is a pioneer in this work.

It is a well-known fact that certain species of bacteria are positively antagonistic to others as regards growth and development, an example of this being the well-known disappearance of the normal flora of the urethra in the male during the course of an acute gonorrhœal urethritis.

The most common organism found in alkaline cystitis is the bacillus proteus vulgaris. There are cases reported, however, in which the staphylococcus, streptococcus, and the colon and tubercle bacilli were found, but there is no doubt that the proteus vulgaris is the organism found most frequently to be the cause of cystitis when the urine is strongly alkaline. Lavage, instillations, etc., have very little effect, especially in those cases having a tendency to incrustation. In these patients there are bacteria growing which require an alkaline or faintly acid medium. The injection of any acid, mineral or organic, will afford a temporary change in reaction because of the frequent evacuation of the bladder. In introducing an acid-producing bacteria some unquestionably remain during urinations, become implanted, multiply, and create enough acid to transform the urinary reaction. In the bacterial battle which follows, the bulgarian bacillus soon demonstrates its superiority and so overwhelms the proteus that changes in the patient are often seen immediately.

It might be said, to quote Dr. Caulk, that the technique of injecting an emulsion of this bacillus into the bladder might be faulty for two reasons: (1) because of the danger of introducing other bacteria and (2) because these bacilli might be harmful. To defend the treatment against these objections it may be said that several cultures of these tablets of Hynson and Westcott were made by Dr. Thomas of Washington University, and on each occasion a pure culture of lactic acid was obtained. The bulgarian bacilli seem to lack resistance to chemicals and even to their own acid products, because when a certain degree of acidity is reached they die. One bladder irrigation of 1:20,000 bichloride will completely destroy these organisms.

Experimental work on dogs shows that injection of the organisms into the bladder followed by traumatism produces no evidence of inflammatory change in the mucosa, and the urine four days after injection is sterile; so I feel sure we can use this organism with safety in the bladder.

Dr. Caulk reports a very interesting case of alkaline cystitis with ulceration, deposition of lime salts, and the formation of papillary areas also incrusted with calcareous material. This patient had been operated upon a number of times, and the ulcers curetted, all forms of irrigations and instillations having been used with practically no benefit to the patient.

At the time Dr. Caulk began to use the bulgarian bacillus the patient was in a frightful condition, being troubled with tenesmus, urinary frequency, blood, and offensive urine. Following the first injection the patient spent a much more comfortable night and was finally cured by the instillation of emulsion of the bulgarian bacillus.

The following is the method we have em-

ployed in our own cases: The bladder is first irrigated with sterile water (this is very important, as any antiseptic will probably prevent the growth of the bulgarian bacillus); three or four tablets are then dissolved in an ounce of sterile water, the mixture being well stirred, as these tablets are only in suspension. The solution is then injected into the bladder with a syringe and the patient is told to retain it as long as possible. The effect is often noticed at once, as the urgency and pain are diminished.

I will briefly cite a few cases showing the prompt action of this organism:

CASE 1. A patient 76 years old on whom a suprapubic prostatectomy had been performed. This operation was performed just before I left to hear Dr. Caulk's paper. When I returned six days later the patient was in a very precarious condition — inactive, somnolent, pulse weak, appetite poor, and showing every evidence of sepsis; although he had had frequent bladder irrigations, urinary antiseptics, etc., the putrid odor from his urine permeated his room. The edges of the suprapubic wound were necrosed, gangrenous, and covered with calcareous deposits.

The patient's condition was alarming and it seemed as if he would have an unfortunate ending. Urine collected from the suprapubic wound was strongly alkaline and contained myriads of large bacteria that proved to be the proteus vulgaris. The patient's bladder was irrigated with sterile water through the suprapubic wound, and four tablets dissolved in an ounce of sterile water were introduced into the bladder and allowed to remain. This was repeated every four hours, and on examining the patient next day his general condition was found to be much better. The offensive odor had entirely disappeared, the only odor noticeable being a slight sourness due to the bulgarian bacillus, and the urine was strongly acid. The tablets were then introduced three times daily. Seventy-two hours after the first introduction of the bulgarian bacillus the slough had entirely disappeared from the edges of the suprapubic wound, the deposition of lime salts had ceased, the urine was clear, and the patient's general condition was most satisfactory. The use of the tablets was continued three days longer. The patient made an uninterrupted recovery, the urine continuing to be acid. We have used this treatment on several patients having hypertrophied prostate where there was suffering from recurrent attacks of frequency and tenesmus with alkaline urine and but little residual urine, and the results have been quite as striking.

We recently had a patient who gave a history of chills, fever, recurrent attacks of urinary frequency, and tenesmus, extending over a period of three weeks, with cloudy alkaline urine. Cystoscopic examination showed a bright velvety area just behind the right ureteral orifice. X-ray negative for calculus. The possibility of tuberculosis of the right kidney was considered, but several urinary examinations failed to show the bacilli.

Guinea pigs inoculated continued to gain weight. This patient's right-kidney urine was strongly alkaline and contained much pus and some blood, while the urine from the left was but faintly alkaline, containing but a small amount of pus. Instillations into the bladder improved the patient's condition, but the urine from the right kidney continued alkaline and the presence of pus continued in the urine. Culture from the ureteral catheter gave a pure culture of staphylococcus aureus. The kidney pelvis was injected with seven cubic centimeters of four per cent silver nitrate. Two days later the urine still contained pus and was alkaline. I then thought I would try injecting the kidney with the bulgarian bacillus. Two tablets were dissolved in ten cubic centimeters of sterile water and injected into the kidney pelvis through the ureteral catheter. The patient was comfortable for thirty-six hours when he had quite a severe chill, temperature going to 103.5° but becoming normal in twelve hours. The day following the injection, the patient's urine was acid, and although I made two more injections of bulgarian bacillus into the bladder no more treatment was directed to the kidney. The patient has now been away from the hospital three months, his urine remaining clear, acid, and free from pus.

Although a great deal has been said regarding the bulgarian bacillus, it is unquestionably a most useful therapeutic agent in cases of bladder infection with alkaline urine.

DEPARTMENT OF TECHNIQUE

CANCER DESTRUCTION BY RADIUM[1]

By JOSEPH B. BISSELL, M.D., F.A.C.S., New York
Visiting Surgeon, Bellevue and St. Vincent's Hospitals

BY the word destruction is meant local removal of a neoplasm, in contradistinction to cure, the term cure meaning complete and permanent effacement of the malignant growth and its non-recurrence in any other part of the patient. The word cancer in this paper is used in its generic sense and covers all malignant growths. The rationale of the complete removal of a tumor by radium application can be satisfactorily demonstrated only by a thorough microscopical examination of the involved tissues, carried out from time to time during the active treatment and after its completion. In this way the histological changes in the cells, morbid as well as normal, may be anatomically demonstrated and the actual effects of radiation upon these new growths, as well as upon the surrounding structures, may be accurately ascertained beyond question and in a definite manner.

Often, however, for good and sufficient reasons apparent to all of us, it is impossible to make these observations. We then have to depend upon the findings as exhibited by the clinical and objective symptoms.

A considerable amount of evidence is on record, from the writings of some of the best modern pathologists, which shows the structure alterations taking place during the application of radium. To quote only a few authorities:

Gauss describes the histological changes observed in ten pieces of tissue excised at various periods in a case where myomata were under treatment by radiation. Striking changes are shown: At the beginning a microscopical section shows adenocarcinoma; two weeks later a section in the same location shows connective-tissue and cancer nests; three weeks later still, the cancer evidences have disappeared and the microscope discloses nothing except benign tissue with epithelial débris.

Degrais and Bellot pointed out, in a recent publication, that when epitheliomatous cells are exposed to radium there is a hypertrophy of the nucleus and degeneration of the protoplasm, together with a certain amount of keratinization. "This process was continued, and twenty days or so after radiation these epitheliomatous masses became transformed into keratinized débris. The formed elements break up and disintegrate; young fibroblasts and connective-tissue cells, lymphatic cells, and polymorphonuclear cells infiltrate the growth and carry on a phagocytic function, and meanwhile cicatrization occurs at the expense of the hyperplastic and regenerated stroma of the tumor."

In a case reported by Aikins, of Toronto, a bone tumor involving the right tibia was removed January 6, 1914, and examined. The pathological examination showed that it was a myeloid and round-celled sarcoma. Three weeks after radium treatment a portion of tissue was removed from the original location for further examination. The pathological report is as follows:

"The tissue examined consists of a portion of large fungating growth removed from the anterior portion of the thigh.

"The epidermal elements have completely disappeared and their places have been taken by a large fungating tumor which clinically is sarcomatous. On microscopical examination one sees that this is a sarcoma with very large cells and a few spindle cells. The sarcomatous tissue infiltrates all through it, there is no tissue reaction, but a connective-tissue stroma is present which is œdematous and filled with a pigment which is evidently hæmosiderin. The nuclei are often very large. The size varies, but everywhere it shows mitotic figures and conforms to all the characteristics of malignant sarcomata.

"On June 4 the tumor was exposed continuously to the radium rays, a dosage of 240 centigram hours being given, and on June 15 another portion was removed.

"Here we see wonderful changes. In place of the sarcomatous fungating tumor we find a structure much reduced in size. The large cells of the growth under the influence of the rays have changed to smaller connective-tissue and spindle cells. The cells show necrosis and necrobiosis. The connective-tissue cells have been mobilized and the leucocytic infiltration is most intense, due doubtless to the trophic stimulus. The connective tissue has been vascularized, not by a mere inflammatory reaction, but by a truly specific stimulus, which has expressed itself in the definite form of connective-tissue elements."

Another evidence of the histological changes produced by radium rays upon cancer-cells is

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shown in the case reported by Drs. Aikins and Simon, of Toronto, in the *Dominion Medical Monthly*, September, 1914. This patient twelve years previously had the right breast removed for carcinoma. In March, 1914, a recurrence was noted in the left breast. It consisted of a hard mass of induration about one and a half inches in diameter. The nipple was retracted and glands were present in the axilla, together with other typical symptoms of carcinoma. Radium was applied several times by a capable expert, and at the end of the month of May the breast was removed. The following is the pathologist's report:

"A specimen of what proved to be an adenocarcinoma of the breast was submitted to us after being subjected to the influence of radium. We found the upper portion of the skin which previously had been reported to be infiltrated with the growth to be totally free from any remains of malignant tissue. Deeper in the tissue, however, there seemed to have survived a diffuse growth, the cells being smaller as we neared the surface. These cells would also have been destroyed had radiation been continued.

"Some of the carcinomatous cells were markedly hypertrophied, some were monstrous, some vegetative, while the protoplasm showed marked eosinophilia, proving beginning degeneration. The various tissue elements had become broken up and eosinophilic; young fibroblasts had evidently replaced the growth in the parts nearer the surface."

Dominici and Barcat examined a specimen from healed radium burns. The tissues were composed of fibroblasts and connective-tissue bundles parallel to each other and parallel to the surface of the skin. The fixed cells became rarified, the chromoplasm of the parenchymal cell had disappeared and was changed into hyaloplasm. They noted that the connective-tissue bundles separated and the fibroblasts became thickened. These observers also discovered that those portions of the tissue which had been subjected to radium became essentially differentiated from those not within the radium field. All tissue-cells are affected by the rays. The cells of the neoplasms are especially susceptible. As a general rule the more vicious the cell the greater the effect upon it of the ray. Normal tissue-cells are injured, but where they are in close relation with cancer-cells it was discovered that before they are hurt beyond recovery the cells of malignant growths are either destroyed or so changed that normal, healthy structure is substituted. Normal cells appear to have a greater resistance or a lesser susceptibility and are not so easily influenced by radiation. They recover more quickly after injury while the cancer-cells so affected recover their activity slowly or not at all, being often replaced instead by normal connective tissue. This is the so-called selective action.

The conclusions drawn by Teitschlaender,[1] of Vienna, after repeated pathological examinations of malignant tissue exposed to radium applications are as follows: "The chief action seems to be the inhibition of karyokinesis and activation of leucocytes and destructive changes, allowing the abnormal tissues to degenerate."

In sarcomata the retrogression takes place according to the following law:

1. The size of the body and the nuclei of the large cells decrease.

2. As they shrink the neoplastic elements elongate, but the shape of the nucleus becomes regular, and they eventually assume the form of large embryonic connective-tissue cells, forming into a celled mass similar to that of a true fibroma. Thus we may emphasize the fact that sarcomata are transformed by radium into a tissue analogous to that of a fibroma with myxomatous changes.

As regards epitheliomata and carcinomata under the influence of the radium rays, we find that—

1. The cells gradually diminish in size and staining properties.

2. This atrophy corresponds, not to the metamorphosis of those definite, formed elements, but to their destruction, as shown by keratinization or absorption.

3. The epitheliomatous cells disappear either by means of progressive absorption of protoplasm and nuclei through the leucocytic infiltration or by a sort of granular degeneration.

The other processes associated with the development of every epithelial tumor are arrested, while vascular connective tissue is reorganized according to the method just described.

As proof that the changes initiated by radium are such as lead to immunity, great importance must be attached to the cellular infiltration, first leucocytic, then later a round-celled infiltration. It has recently been shown these activities require different reactions of the tissue for their function; hence radium must affect the blood. These infiltrations have always been noted in all cases of animal experimental transplantation of malignant cells and always accompany the cases in which the animal becomes immune and the tumor disintegrated.

The pathological evidences of chemical, histological, and anatomical alterations in morbid and normal tissues from the effect of radium applications seems, therefore, to be abundant, substantial, exact, and incontrovertible. The

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clinical proofs of this action of radium are illustrated in the following cases. For the purpose of this paper those only have been selected in which the tumors have been proved by pathological examination to be malignant and in which, under treatment, the growth has disappeared.

CASE 1. J. S.; farmer; age 61; March 21, 1914. Patient has basal-celled epithelioma of the neck, recurrent. Has an extensive and deep ulceration extending from the root of the ear down the neck. Part of the lobe of the ear is destroyed. The ulcerated surface is about three by two and a half inches in extent. The large vessels of the neck are exposed. Besides two previous operations the ulcer has been recently thoroughly cauterized. Forty milligrams of radium applied for 9 hours. April 10, 40 mg. of radium applied for 9 hours. April 16, 40 mg. of radium applied for 9 hours. April 23, the lobe of the ear is entirely healed and covered over with new skin, and the ulcer is reduced to about half an inch in diameter, which is healing in rapidly. Forty milligrams of radium applied for 12 hours, and the patient left for his home the next day, writing me at the end of two months that the ulcer was entirely healed and that there was no further use for dressings. He received in all 1,560 mg. hours of radium in the course of his treatment.

CASE 2. J. F. F.; storekeeper; age 57; October 9, 1914. Patient has a lump about the size of a small orange involving the upper part of the sternum at its junction with the clavicle extending posteriorly into the mediastinum and externally into the right cervical region. Three weeks previously a tumor of this size had been removed by operation and the wound had healed kindly and rapidly. Recurrence began about a week afterward. Pathological report as to tumor was that it was a carcinoma. Today 101 mg. was applied, properly screened, over the region and allowed to remain for 20 hours, patient going to his home in the country next day. October 16, he returned complaining of a slight burning of his skin, but with the tumor reduced to about half its size. October 29, skin is still very tender, but the tumor has almost entirely disappeared. November 12, very slight evidence of tumor remaining, but he has two well-marked radium burns; one rather deep eschar about an inch in diameter and another about half an inch in diameter, both painful and discharging — one to the right and the other to the left of the upper border of the sternum. December 10, the two sides of the sternum and each clavicle in the sternum region appear to be similar and normal. No evidence whatever of any tumor. The skin is still tender over the burned regions. Patient discharged. One radium application of 2,020 mg. hours.

CASE 3. Mrs. S.; age 40; housewife; seen September 10, 1914. History of carcinoma of the breast of two years' standing. Breast removed November 10, 1913. Small nodules scattered around the wound and in the surrounding skin; recurred in May, 1914. The pathologist's report was adenocarcinoma of the right breast. At this date 101 mg. of radium applied in divided tubes for 30 hours over a circle of about six inches in diameter. October 1, well-marked radium burns present, but healing; some of the nodules have disappeared, but as the induration along the wound is still marked another application of radium was advised but refused on account of the burns. November 2, radium burns still present but slowly improving. A number of new-skin nodules have appeared outside the circumference of the others. One hundred and one milligrams of radium applied for 15 hours. December 6 radium burns still severe. One large burn on her side over a recent nodule is very deep and troublesome and is about an inch and a half in diameter, excavated and quite painful. One hundred and one milligrams of radium applied for 9 hours, changing the location of the application every hour. December 19, condition about the same except that some of the burns are healed. There are present at least a hundred nodules, some of them quite large. One hundred and one milligrams of radium applied for 22 hours, changing the site of the application every two hours. The radium was screened by 8 mm. of felt as well as by 0.5 mm. of lead. December 23, nodules are slowly disappearing and only one of the large ones remains. February 5, 1915, patient is improving. Most of the burns have healed. The large burn posteriorly is still present, but the induration underneath it has gone, as have apparently most of the other nodules. Patient's general condition is very much improved. She has increased in weight, has better color and appetite, sleeps well, and is quite contented with her condition. One hundred and one milligrams applied to various parts of the lesion for 20 hours. April 15, patient has had two applications of radium of 101 mg. for 20 hours each time since the last note. The nodules have all disappeared except two or three suspicious spots in place of the hundred and more indurations she had when the treatment began. Two small radium burns still persist. Ninety milligrams of radium applied for 20 hours to the suspicious points. In her treatment this patient received in all 5,536 mg. hours.

CASE 4. Madame L. D.; age, 69; occupation, governess. Patient gave a history of having had a laparotomy for removal of a tumor of the uterus seven years ago. Six months previous to my seeing her she had a tumor removed from her back, which the pathologist reported to be a round-cell sarcoma. One month later recurrence took place. On admission to the hospital, at the site of a scar over the border of the left scapular spine, at its inner extremity, was seen a small ulcerated growth with characteristic odor. This, the patient stated, had been present for about two weeks. On February 26, 1914, this growth was removed together with the remaining scar-tissue. This was reported by the pathologist to be sarcoma. The operation wound healed kindly, but on March 10, as there seemed to be some tendency to infiltration of the skin at this point, 40 mg. of radium element were applied for 2 hours. After the first application there was no further discharge; the induration and slight tendency to ulceration which had been present disappeared; there was no further pain or irritation of any kind, and the site of the operation wound was apparently normal except for a white scar line. Examination on May 10 showed no evidence of any return of the growth, but 40 mg. of radium were again applied for 2 hours. April 10, 1915, there was no return of the growth. This patient received in all 1,120 mg. hours.

CASE 5. J. McE.; age, 55; occupation, waiter; August 27, 1914. Twelve days ago the patient first noticed a tiny abrasion inside the lower lip to the right of the middle. On September 30 this had increased to the size of a large pea. October 20, the whole lesion was excised and the wound sutured. The pathologist's report was sarcoma. October 21, 20 mg. of radium in two tubes were applied for 1 hour. October 23, the wound appeared entirely healed and stitches were removed. October 29, lip was apparently normal. Incision had healed by first intention. Thirty-six milligrams applied for 30 minutes. November 12, 20 mg. were applied to the inner surface of the lip and 26 mg. to the outer, over the line of the incision, for 40 minutes. December 10, 20 mg. in two tubes applied for 40 minutes. The line of incision has practically disappeared. There has been at no time any local reaction.

April 5, up to date there has been no return of the tumor. This patient had 550 mg. hours.

CASE 6. Rev. C. McC.; age, 70; occupation, ecclesiastic; December 26, 1914. This patient has growth in front of left ear, raised three-quarters of an inch above skin surface and about one-half inch in its longest direction by three-eighths of an inch in width, with superficial ulceration. This tumor has been growing for several months. Without removal 10 mg. of radium was applied for 20 minutes. December 30, no apparent reaction of the skin or tumor. The growth was removed with curved scissors under local anæsthesia and immediately afterwards 50 mg. of radium was applied to the excavated base. Examination proved it to be epithelioma. January 27: Since the removal of the growth he has made weekly visits and 10 mg. of radium have been applied each time for 10 minutes. February 8, growth seemed to be slightly filling in from the bottom. Twenty-five milligrams of radium were applied for 10 minutes. March 10, up to date 10 mg. of radium for 10 minutes each visit have been applied for four visits since the last report. The ulcer has been completely destroyed and new skin is running in from the edges. There is no evidence of radium burn. April 6, patient called for observation. There is no change in the condition. Patient was told to return in a couple of months to see if further treatment was necessary. April 11: He died this morning of a sudden attack of pneumonia. In all this patient had 3,200 mg. hours' treatment.

CASE 7. F. W.; age, 16; school girl; March 17, 1914. Patient has suffered for several months from enlargement of the left lower jaw and adjoining lymphatic glands. Pathological examination of one of the glands showed it to be sarcomatous tissue of spindle-celled variety. Forty milligrams of radium applied in divided doses for 4 hours. March 20, no local reaction from the preceding treatment; the swelling of glands and jaw was markedly lessened; 40 mg. of radium again applied for 4 hours. Two weeks later the patient appeared to have entirely recovered. There was no irritation or redness of the skin over the tumors. April 17, 1915, the patient's mother reports that patient is entirely well. She had 320 mg. hours.

CASE 8. F. C.; age, 42; occupation, broker; October 17, 1914. Patient has epithelioma of the floor of the mouth involving the lower jaw at the median line. This tumor was removed and the pathological report confirmed the diagnosis. October 22, 45 mg. of radium applied for 10 hours in divided doses to the inside and outside of the jaw, one tube of 25 mg. being applied 10 hours under the tongue close to the median line. October 29, under surface of the tongue somewhat inflamed and tender. Ten milligrams of radium, well screened, applied to the under surface of the tongue at affected point and 51 mg. to the under surface of the chin for 4 hours. November 12, no return of the tumor noticed, but there is a slight tenderness and superficial swelling at the root of the tongue behind the teeth, at the site of the cicatrix. Skin on the under surface of the chin is red, tender, and scaling. No radium applied on account of tendency to burn. February 9, 50 mg. applied for 22 hours to the under surface of the chin. On account of a well-marked burn on the under side of the tongue no radium is applied on the inside of the mouth. April 4, 1915, the radium burns have all disappeared and there is no evidence of any return of the growth. He has a slightly enlarged and tender lump in the middle line behind the prominence of the chin. Seventy-one milligrams of radium applied to this point for 8 hours. This patient had in all 2,662 mg. hours of treatment.

CASE 9. J. W.; age, 51; occupation, ship's carpenter. This patient had epithelioma of the eyelid. Eleven years ago he was operated upon for a similar tumor said to be malignant. The present tumor was removed, and pathologist's report showed it to be epithelioma. After excision the wound was united by three stitches, which parted on the third day, leaving a gaping wound. This was resutured, and at the same time 10 mg. of radium were applied for 20 minutes. No evidence of radium burn was noticed from either of these applications. At the end of three weeks from the first operation 10 mg. of radium were applied again for 20 minutes and the patient was discharged. This patient had 600 mg. hours' treatment. No recurrence when seen April 20, 1915.

CASE 10. J. S.; age, 58; occupation, farmer; June 20, 1914. He presents himself with a large excavated ulcer of the base of the tongue extending forward along the right side of the tongue and across the back of the tongue to the left side. The tongue is badly swollen; saliva is excessive; great difficulty in masticating, and it is almost impossible to swallow food or saliva. The whole tongue is exceedingly painful. The submaxillary and cervical glands of the right side are swollen and tender. He has lost about 40 pounds in the past five weeks; is unable to sleep from the pain; cannot take nourishment except in very small quantities, and is practically unable to swallow or breathe with comfort, lying down. His whole condition is pitiable. The tissue taken from the ulcerated edges of the sore by pathologists in his home town has been reported as epithelioma. One hundred and one milligrams of radium in four separate tubes with two mm. of lead screen applied well back on the right side of the tongue and covering part of the ulceration, for 10 hours; 5 mg. of radium also applied over submaxillary glands and changed from time to time. At the end of 24 hours the patient was discharged to go home to the country with the request to return in September. On August 25, the patient returned for observation. The ulceration at the back of the tongue had cicatrized; the swelling of the glands had disappeared; enlarged glands could no longer be made out in neck; the patient had increased 20 pounds in weight and was able to masticate and swallow any kind of food; extra secretion of saliva had ceased. Patient considered himself cured. Curiously enough he had a radium burn on the tip of the right side of the tongue, which he said was very much better than a few weeks ago and was evidently healing. In all he had 1,908 mg. hours of treatment.

CASE 11. Miss A.; age, 32; occupation, clerk. Entire breast and axillary contents removed on February 15, 1914. Reported as adenocarcinoma. October 20, small nodules which had appeared in scar removed. November 21, several new, small indurations have appeared in the scar and around it. The largest is the size of an almond. Thirty-five milligrams of radium were applied to the most prominent lumps for 12 hours. December 22, marked radium burn over site of larger tumor, which is nearly gone. The smaller one has disappeared, but a number of new small nodules, the size of rice seeds, are present. One hundred and one milligrams of radium applied for 22 hours.

These cases, although few in number, represent a variety of malignant tumors, all of which are susceptible of removal by use of radium. They do not by any manner of means represent the large number of patients afflicted with cancer of various stages and conditions where the degree of the disease and complications are such that our present knowledge and experience do not

permit us to encourage them to hope for a cure by means of operative procedures, the use of radium, sera, vaccines, or any other known anticancerous therapy. None of the above-reported cases are claimed to be cures. Time enough has not elapsed for such a claim, but as we learn more of the action of radium it is believed that more of the cancer cases which are looked upon as hopeless at present may be relieved by radium alone or by a proper collaboration of radium with the various other remedies at our disposal. In spite of the great advance recently in the methods and technique in using radium, there is still much to be learned. The amount needed depends upon the different purposes of application, the different depths of tissue to be affected, the variety of tissue, the degree of malignancy, its stage, the length of time of application, and many other factors still to be settled. All these indications can be defined only after much experimentation, long continued, together with a proper appreciation of our rapidly accumulating pathological knowledge of the action of this powerful remedy on living tissues.

Many phases are developed during the course of radium treatment. Certain cases of malignant growths yield rapidly to small quantities of the remedy; on the other hand, others are stimulated apparently by small doses. Some skins are extremely sensitive to very small quantities of radium. Other patients have skin which is not affected at all by large quantities continuously applied and frequently repeated, without regard to the protection supposed to be given by screening.

Curiously, exactly similar cases of malignant growths rayed exactly the same way, with the same amount of screening, the same length of time of application, in persons of as near as possible the same age and period of time of tumor, and where the previous operative treatment was similar, may and do give exactly opposite results. For example, Cases 3 and 11 were precisely similar to another case not reported here, where the recurrent nodules persisted and increased in spite of similar treatment in every way. The pathological report was the same; recurrence took place in the same manner, but after one 15-hour application of 100 mg. she went from bad to worse and died in a few weeks. My feeling is that one application was not sufficient and that in spite of apparent failure the treatment should have been persisted in.

To the lay mind a very serious complication is the burn which sometimes follows the application. This may be extensive and deep and at times very painful and difficult of cure.

Some of my patients have noticed the more rapid disappearance of portions of the growth under the burned area than under that portion unaffected in this manner. These patients sometimes ask to have the radium left on long enough to produce an eschar, believing this to hasten the cure.

The closer the radium to the object the greater the effect of the rays. As the rays shoot out in every direction from the center the ideal course of treatment would be to have the radium as nearly as possible in the middle of the tumor. Therefore a malignant growth in one of the normal tubes of the body and within reach of radium application — as, for instance, in the œsophagus, or the rectum — is theoretically much more susceptible to treatment, especially if the malignant growth surrounds the canal than where the neoplasm can be radiated from one surface only. If there is a sinus running to or through the tumor, or if it is in a location where it can be pierced to accommodate the insertion of the radium, satisfactory treatment can also be carried on. When neither of these methods is possible, we have to resort to what is called cross-raying or cross-firing. In this means of treatment we divide the radium into capsules and place it on the opposite sides of the growth, protecting the skin from the burning rays as much as possible by means of screens of different thickness. All these details are matters of technique and depend upon the individual patient and the disease as well as upon the experience of the operator and upon his personal equation.

So little is yet known of the action of radium on living tissues and so much is still to be learned that, working as hard as one can and despite the vast amount of material, even with an ample quantity of radium, it may still be years before a proper and successful method of treatment applicable to each individual tumor can be satisfactorily and efficiently worked out.

Here are twelve patients with new growths, pathologically and clinically malignant. These neoplasms have disappeared during radium application. Following their destruction or removal the tissue at the former site of these tumors is now normal and remains so. Certainly these results merit our further careful consideration.

A MODIFIED GAS-OXYGEN-ETHER APPARATUS

By THOMAS L. DAGG, M.D., Chicago
Anæsthetist to St. Luke's Hospital

I HAVE used during the past six years in my anæsthetic work various makes of apparatus for the administration of gas-oxygen-ether. All of them I found had some good points, and likewise all of them had features which were more or less impracticable. For instance, one would be too bulky and heavy to carry around; another would have so many keys and attachments as to confuse the anæsthetist. Others would have warming devices which are not only unnecessary but positively dangerous, especially the flame in close proximity to ether. Others again were not portable at all; many of them possess a long tube between the rebreathing bag and the patient's face, which, in my opinion, does not contribute to the patient's comfort nor to the efficiency of the anæsthetic; and so on down the line. So that what I am offering in the illustration herewith represents not so much in orginality on my part as it does a combination of good features from various makes of apparatus which I have found by experience to produce good results and meet all the requirements of a good gas-oxygen-ether apparatus, at the same time dispensing with the unnecessary and impracticable parts of the other devices.

I am using here as a stationary outfit for hospital work a Teter stand with the bags removed and bottles substituted, so as to give the sight-feed principle of Boothby, and which is also used at present on the Gwathmey-Woolsey apparatus. Then I carry my gases through a small 5/8-inch rubber tube to a Coburn bag and valve piece attached to a Teter mask which has had the expiratory valve removed and the hole closed. The valve arrangement attached to the Coburn bag is also used with some slight modification, I believe, by the White Dental Company in their new apparatus. It controls the gases from the bag to the patient by a sliding inner tube with a peg protruding through a slot for control by the thumb and forefinger of the hand holding the

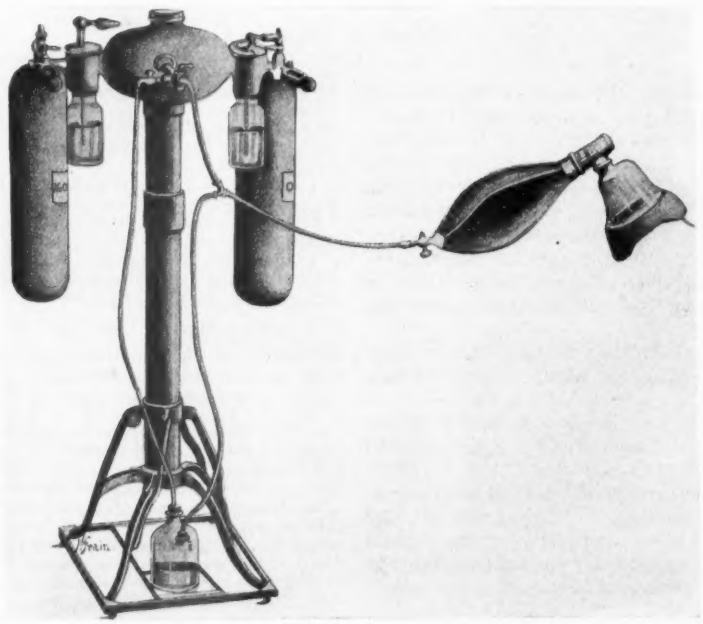


Fig. 1. A modified gas-oxygen-ether apparatus.

mask. The inner tube contains the valves which allow:

(1) Air breathing only; (2) inhalation from the bag and expiration through the valve outwardly; (3) a to-and-fro breathing into the bag for the rebreathing method.

Now, when ether becomes necessary for complete relaxation, it is supplied by converting the flow of gases down over the ether contained in a Wolf bottle of 500 ccm. capacity and then on to the bag. This can easily be gauged from a very slight odor of ether up to a sufficient ether saturation to obtain results. If a smaller Wolf bottle is used, this cannot be done, as sufficient ether vaporization cannot be produced from a smaller surface exposure.

Now, to make this a portable apparatus, one which may easily be put into a small grip for carrying around, simply disconnect the tubing from the stand proper and attach it to a double reducer. Attach the double reducer to the nitrous oxide and oxygen cylinders which stand upon the floor; shorten the tubing which goes to the ether bottle correspondingly, the ether bottle also standing upon the floor. In this way you have just as good and practical an apparatus as you have with the stand, except you have not the sight feed. The reducer, however, has this advantage, that it gives you a constant and steady flow of gases which cannot be obtained without it, and this feature is greatly to be desired. One final word about this apparatus: It will appeal to the obstetrician where he desires nitrous oxide-oxygen to obtain, in a safe and sane way, the much-talked-about "twilight sleep" in his obstetric cases.

The expense of assembling the various parts of this apparatus ought not to exceed thirty or forty dollars, outside of the stand, which is not an essential part of the portable outfit.

A NEW PROCEDURE FOR THE CURE OF CHRONIC SYNOVITIS

WITH CASES

BY F. J. COTTON, M.D., F.A.C.S., BOSTON

SOME years ago the notion occurred to me that chronic joint hydrops, occurring as it does from time to time without causative, traceable infection, was surgically a question of drainage, that its persistence depended on a loss of absorptive power in the synovial membrane, a condition analogous to that presented by chronic scrotal hydrocele. It seemed to me that we were dealing, in this class of cases, with a lack of absorption rather than with any persistent oversecretion.

If this is true, why can we not deal with this troublesome condition by means of subcutaneous joint drainage?

An opening into a joint is ordinarily closed in early; the epithelial layer grows over the gap, and we are where we started.

How can we make a *permanent joint drainage* to meet *chronic* conditions? The answer is: By securing a gap in the periphery of the capsule that *cannot be covered with synovial membrane*, in other words, a *permeable scar* open to the joint.

In 1912 I had my first opportunity to try this theory on a young man sent me by Dr. D. Sweet of Hartford, Connecticut, who showed a typical intermittent hydrops of one knee of three years' duration, without any obvious underlying lesion. It was of the rather usual type: ten days clear; then pain; then one day of sharp effusion; one day at the apex; one day of rapid absorption, and then another ten days clear.

I operated just after an attack. The moderately lax capsule was opened for an inch and the synovial membrane rolled out and sutured; the wound in the muscle and the skin wound closed.

Following the operation this young man had recurrent attacks of pain as before, but never for the year that I kept track of him was there any joint effusion at all.

I chanced on no other case suitable for this procedure until last autumn, though the condition of chronic, uncomplicated hydrops is not really very rare. The report of this case follows:

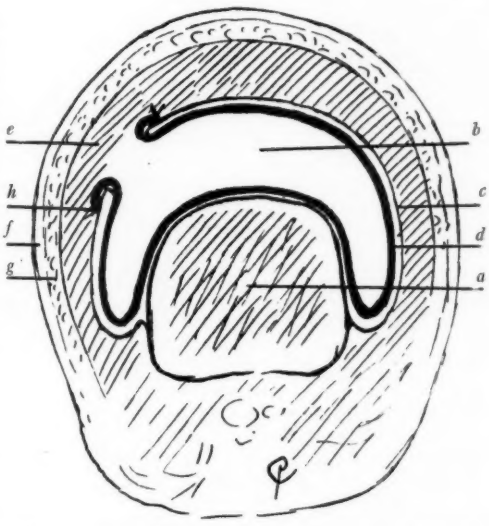
J. McN., student; at one time an athlete of note, at another time a building contractor's assistant; 33 years old; tall, rangy, and very powerfully built, though weighing only 160 pounds. He was referred to me by Dr. A. McK. Fraser, on account of chronic hydrops of both knees. The effusion on the left side had been present for three years, though at one time, about two years ago, the swelling is said to have gone down to almost nothing for a time. The effusion came on gradually and has been almost painless, though very crippling on account of the limited motion, due to the mechanical effects of distention and to the loss of power from the very marked reflex atrophy of the quadriceps muscle. About a year ago there came on a

like swelling of the right knee, less, but in all other respects corresponding to that on the left. When he came to me the knees were alike, save that the right showed approximately two-thirds the amount of fluid present in the longer-affected left knee. The left knee could be flexed hardly beyond the right angle, on account of mechanical hindrance from the tense joint. On the right, motion was a little less limited. There was no tenderness to touch; no infiltration of the capsule; no sign of anything save free fluid within the joints; no indication of bone damage. On both sides quadriceps atrophy was obvious and rather extreme, considering the powerful general physique. No etiological factor could be arrived at, save that the patient had hurt the left knee in football work in his youth (never very seriously) and that he had had what was regarded as an apical tubercular process, which had since healed under fresh air treatment, two and a half years ago. To the *surgical* ear the apices now show nothing abnormal. There was no question of specific history. This was *not* the symmetrical congenital luetic hydrops of Clutton.

Operation was advised and was done on December 5, 1914. A long, curved incision on the inner side of the left knee, high up, exposed a considerable mass of vastus internus muscle, which was split in the direction of its fibers. Beneath this lay a firm layer of fibrous capsule; still farther beneath, and well differentiated, lay the synovial lining, thin, pale, and abnormally tough in consistency. On opening this layer from one to one and a half ounces of viscid, clear, almost colorless fluid escaped. On exploration of the joint there appeared no lesion of any sort on the pale synovial membrane, and the joint cartilages were approximately normal, though perhaps more white and less blue than in the average. Dr. Mallory's later report on the excised membrane gave no data, save for the changes of a chronic inflammation.

The synovial membrane was pulled out through the cut in the fibrous capsule (a cavity of 1x1¼ inches) and then rolled back and carefully sutured (with catgut), so as to leave *no exposed edge* of synovial membrane. The joint was washed out with normal salt solution and left half-full. The vastus internus muscle was brought together over the gap with lightly drawn mattress sutures of catgut, and the skin was closed in the usual way with interrupted sutures of silkworm-gut. On the right the same thing was done. There was less fluid, but in all other respects the joint was similar to its fellow. Both knees were bandaged down onto straight ham splints.

For two days there was a bit of temperature, apparently due to the not uncommon irritative effect of ether on a quiescent or healed lung tuberculosis. There was a bit of pain in the right knee, apparently from tight bandaging; for three days some fluid remained in the joints. After this there was nothing to note and the splints were removed at six days. He was allowed to sit up and to walk a little after nine days, and at eleven days was discharged from the hospital. He was seen thirty-nine days after the operation and showed no fluid and no infiltration. Save for the recent scars, there was nothing to note except the quadriceps atrophy, still marked on both sides. There was a little grating of the now *dry* articular surfaces on motion. Motion, by the way, was now much freer than before the relief of joint tension. He complained of no pain, and there was no muscle spasm. Later there was some effusion in the right knee, apparently without cause, save for the negative pressure of the tremendously relaxed capsule. This effusion subsided entirely under the moderate pressure of a Bender bandage, and is still absent February 24, 1915.



Diagrammatic scheme of the drainage-scar operation: a, femur; b, distended synovial cavity (quadriceps bursa); c, fibrous capsule; d, synovial lining; e, muscle layer into the interstices of which the scar affords drainage; f, skin; g, subcutaneous fat; h, the synovial lining everted and rolled back, caught with separate stitches back into the outer surface of the fibrous capsule.

This scheme has worked out successfully in three joints operated on to date; a small series, but unanimous as far as it goes!

The whole notion of the operation is the establishment of a *permanently permeable* scar, not liable to obliteration by growth of the synovial membrane. I hope to establish the possibility of this more conclusively by animal experiments, already laid out.

In the meantime it is respectfully submitted that synovial membrane, like other epithelial and endothelial layers, *cannot grow up and out of a corner;* that total eversion of the membrane, as shown in the appended sketch, gives no point for even a beginning for the covering of the loose open scar that opens into muscle interstices; and that so long as such scar persists there can be no great accumulation of fluid within the joint.

I believe the principle to be new (at least as applied to joints) and worthy of further trial.

SUPRAPUBIC PROSTATECTOMY SIMPLIFIED[1]

By G. SHEARMAN PETERKIN, M.D., F.A.C.S., Seattle, Washington

RECOGNIZING a time limit and that brevity is essential, both in the paper and its discussion, I shall omit etiology, symptomatology, diagnosis, and pathology and limit myself to operative technique. However, the following pathologic classification of prostatic enlargement must be borne in mind:

1. Adenomatous hypertrophy, a pathologic condition that permits of enucleation.

2. Interstitial hypertrophy, a pathologic condition that does not permit of enucleation.

3. Carcinoma, a pathologic condition that likewise does not permit of enucleation.

The technique presented applies to the first and most frequent class of cases, and this fact should be borne constantly in mind during the discussion.

PREPARATORY TREATMENT

Patients should be in the hospital thirty-six hours before operation, except in cases which are difficult to catheterize, are infected, or have pronounced retention and low vitality. In these the duration of confinement previous to operation should consume only time sufficient to prepare them and to recover from the excitement and exhaustion of transportation to the hospital.

GENERAL PRE-OPERATIVE TREATMENT

The evening of entrance the patient should be given a hot sitz bath, with high salt-solution enema, castor oil, ccm. 30 (ounce, 1). Catheterization every six hours, followed by washing out with boracic-acid solution, temperature 110° to 120° F. in percolator.

The following morning, if the bowels do not move freely, a high salt-solution enema should be given. During the day the patient should take hot sitz baths, two or three, according to his vitality; also hot-water bottles should be applied to the bladder and perineum to reduce congestion. The diet should be light. At least eight glasses of water should be given during morning hours. After 4 p.m. no fluid is taken, so patient may have a good night's rest. For the same reason the patient is catheterized at 11 p.m. the night previous to operation and not again until next morning.

The back is prepared for spinal anæsthesia from the fifth dorsal down, employing the usual moist dressings for the sterilization of the field of operation. The pubes are shaved and sterile dressings applied. If a general anæsthesia is employed, pre-operative preparations on the table, such as catheterization, filling the bladder and sterilizing the field of operation, should be performed prior to the administration of the anæsthetic, since, with experience, complete anæsthesia for five to ten minutes is sufficient to perform the entire operation. However, spinal anæsthesia is recommended in practically all cases. So on the morning of operation, two hours previous to operation, high salt-solution enema is given until the water returns clear. One hour prior to operation five to six glasses of water are given to produce polyuria after operation. A hypodermic is also given, consisting of morphine, 1/6 gr. (gm. .01) to 1/4 gr. (gm. .016), combined with hyoscin, 1/100 gr. (gm. .0006), one hour later hypodermic of morphine, 1/6 gr. (gm. .01) to 1/4 gr. (gm. .016), sufficient to make patient drowsy and allay excitement. In adaptable cases the hypodermic may be entirely omitted.

Local pre-operative preparations. The spinal anæsthetic is injected. The solution used is stovaine compound, made after Dr. W. W. Babcock's formula. The technique of administration followed is that advocated by the same author and described in Surgery, Gynecology and Obstetrics, November, 1912. After injection place patient instantly upon his back, then proceed as follows:

1. Catheterize the patient. If infection exists, wash the bladder thoroughly with boracic-acid solution, temperature 110° F. in percolator, until the solution returns clear. Having previously ascertained the bladder capacity, fill the bladder to its fullest capacity, as a full bladder is essential to rapid and correct technique. Obviate guesswork by using a graduated glass percolator and percussing abdomen, as under anæsthesia the capacity of the bladder without danger, due to absence of pain, may be increased.

2. When the bladder is filled, withdraw the catheter and apply Zipser's penis clamp (Fig. 1), as this obviates loss of time, since it is easily removed when necessary without disturbing the sterile operative field.

3. Sterilize the abdomen with soap, ether, bichloride, etc., not iodine. This method avoids the blistering and irritation of the skin, as the skin surface becomes wet during and after operation.

[1]Read before Physicians' Club, Seattle, Washington, January 12, 1915.

Fig. 1.

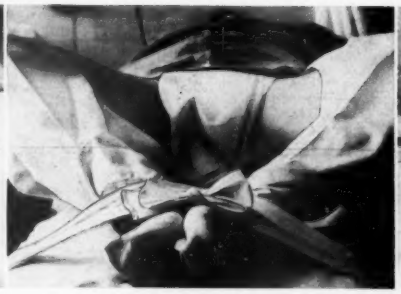


Fig. 2.

Fig. 3.

Fig. 1. Showing the Zipser penis clamp applied.
Fig. 2. The knees flexed and soles of the feet in apposition, with the bandage tied about the ankles and table.
Fig. 3. Feet, legs, and thighs covered with a sterile sheet, well above the groin, leaving the anus exposed.

4. Thoroughly flex and evert knees so as to place soles of feet in apposition. Place muslin bandage, 8′x 4″, about each ankle, draw over insteps and once around feet, so as to keep soles of feet in apposition, and tie; then tie about table, so as to keep knees flexed. This bandage gives perfect position and obviates an assistant (Fig. 2).

5. Cover with a sterile sheet the feet, legs, and thighs to well above the groin, yet leaving anus exposed (Fig. 3).

6. Place double sheet, extending from knees to pubes, across thighs. This will serve as a rest for instruments and yet give free access to rectum without disturbing either sheet or instruments (Fig. 4).

7. The technique for covering the remaining field of operation is that generally pursued—moist towels, with double sheet across chest and four dry towels held in place by towel clips and so arranged as to leave abdomen exposed from pubes to within an inch (2.5 cm.) of the umbilicus.

8. Place on left hand three rubber gloves (Fig. 5), the first drawn well up on arm, the second turned slightly back, and third turned back more than second. The object of this number of gloves is that when occasion demands that the left hand be withdrawn from the rectum the nurse can immediately draw off the outside glove and leave a sterile field without loss of time. The right hand is without glove.

OPERATION

The abdominal incision, two and one-half inches long (6 cm.), is made in the median line. Retractors are inserted and held by assistants so as to expose distended bladder well. With a piece of gauze the peritoneum on the bladder is stripped back as high as possible. In the median line of the bladder, just in front of the junction of the peritoneum with the bladder, a round needle carrying a silkworm-gut suture is inserted transversely, care being taken not to puncture any veins. This suture (Fig. 6) is passed completely through the bladder-wall, mucous membrane, and all, taking a bite of one-half inch (1 cm.), so as to give a firm hold. As soon as passed the needle is removed and both ends immediately clamped with a hæmostat. This suture we term a stay and guide suture. An assistant holds this stitch taut, while the operator inserts a knife as close as possible to the same and directly in front of its center and opens the bladder toward the symphysis for an inch (2.5 cm.). The knife is immediately withdrawn and retractors dispensed with. As the stitch is held taut it pulls the edges of the wound in apposition and prevents the escape of fluid and the collapsing of the bladder. The value of an uncollapsed bladder is apparent; it permits, before enucleation, of a thorough examination, by palpation of the bladder, for stones, the presence of sacculations, etc.

The assistant still holds the stitch taut, and the operator places the back of the index finger of the right hand on the same and, by following it down, immediately enters the bladder wound. This is the part of the operation in which the stitch serves as a guide suture and is very serviceable, inasmuch as it permits one to omit the use of retractors yet enables one to find the opening into the bladder at any time without hesitation, no matter how frequently the enucleating finger is withdrawn.

The left hand should now be placed beneath the transverse sheet (Fig. 4). The Zipser clamp (Fig. 1) is immediately removed from the penis. This clamp, if retained through enucleation, is

Fig. 4. Double sheet placed from knees to pubes across thighs, serving as rest for instrument and yet allowing free access to rectum.

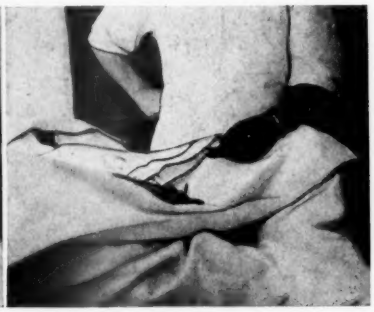


Fig. 5. Shows the three rubber gloves on hand, also the instrument sheet permitting entrance of finger into rectum.

apt to cause retention of blood, which will clot in the urethra, producing post-operative sensation of urethral irritation, tenesmus, etc. The clamp being removed, the index finger or index and middle fingers of the left hand are inserted in the rectum and enucleation begun.

TECHNIQUE OF ENUCLEATION

The technique of enucleation is not difficult to attain if this fact is borne in mind: that the enlarged prostate has practically two capsules, a true and a false one. The true capsule (Fig. 7) exists in both the normal and hypertrophied prostate and consists of layers of rectovesical fascia between which lies the prostatic plexus of veins. In a hypertrophied prostate, on the other hand, due to the growth of the adenomatous masses, the outer portion of the prostatic gland is compressed against the true capsule, and a laminated fibrous envelop, free from blood-vessels, composed of compressed prostatic tissue, is formed, called the false capsule (Fig. 8).

Bearing the above fact in mind, the index finger of the right hand, having entered the bladder, is inserted into the prostatic urethra. Often this forcible dilatation will cause an abrasion in the urethra which will naturally be between the adenomatous masses. Crook the index finger, force it into this opening sufficiently to stick the finger nail into the adenomatous mass, and attempt to hook it out; i.e., pull it toward the bladder. If it gives, which it will, the result is a cleavage in the laminated false capsule. Now push the finger to this point of cleavage, but always keep

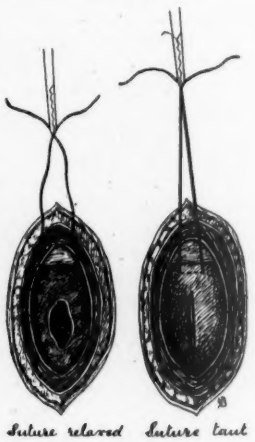


Fig. 6. Suture relaxed and taut.

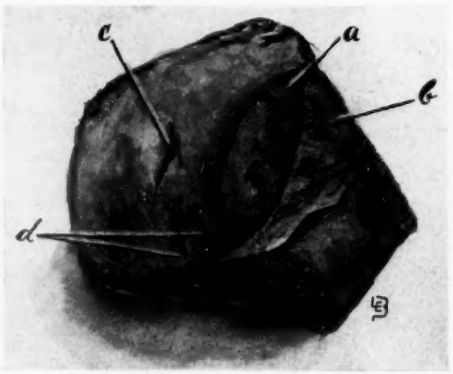


Fig. 7. Normal prostate cut in half. a, prostatic tissue dissected from true fascia; b, showing venous plexus which when injured causes so much bleeding in prostatectomy; c, urethra; d, ejaculatory ducts.

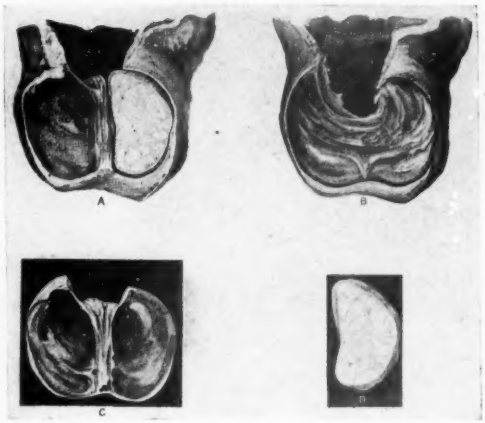


Fig. 8. A, the original specimen in which one lateral adenomatous mass has been removed; B, the bladder and outer part of the "capsule"; C, the inner part of the "capsule" usually removed with the tumors; D, one lateral adenomatous mass; the other was exactly similar but is not shown. (After Wallace.)

the finger hooked and the finger nail toward or into the adenomatous mass, never toward the true capsule with its venous plexus, meanwhile pulling toward the urethra into bladder.

If this technique is followed, the result is practically no hæmorrhage, for after enucleation there is a hollow capsule, consisting of a protecting laminated layer of the false capsule lying against the true, and it is the latter that contains the veins that bleed—the prostatic plexus. But when we go through all the layers of the false capsule and enter the true capsule, hæmorrhage begins and trouble commences.

Every operator, however, must bear in mind that prostatectomy is a blind operation, depending upon the tactile and muscular senses. The tactile sense with experience soon tells the point of attack for enucleation, which is not always the same. Most frequently, it is some point in the urethra, as stated, but sometimes it is through the mucous membrane of the bladder covering the enlarged prostate. But it is the muscular sense which tells if the cleavage is taking place rightly—an important factor.

Having enucleated the prostate, the adenomatous mass is brought to the opening in the bladder, seized by the assistant with a volsellum forceps. If the prostate is in one piece and the prostatic urethra at its junction with the membranous urethra does not give way easily (as frequently occurs), the assistant, before attempting to extract the prostate, should make traction on same,

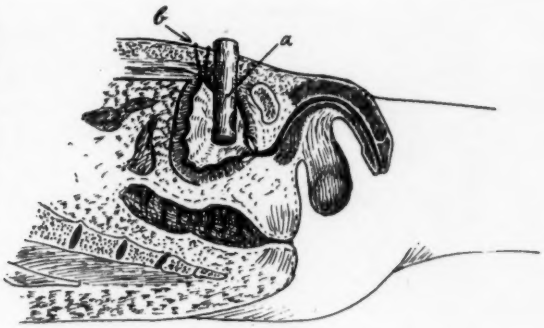


Fig. 9. Drawing showing the tube (a) inserted through the bladder wound, pushed far enough so that the bladder-walls will come above the lateral opening; b, stay suture.

rendering this band tense, then it can usually be torn or cut through with the finger nails. If not, we cut it, employing a full-curved long-handled Emmett's scissors.

After the prostate is removed, the prostatic cavity should be palpated for any small nodules, tags of mucous membrane or prostatic tissue, which should be removed. Especially is this true when the prostate is largely composed of separate adenomatous masses and chronic cystitis exists.

The next step is insertion of the drainage tube. This tube should be ¾ of an inch (2 cm.) in diameter and between four (10 cm.) and five (13 cm.)

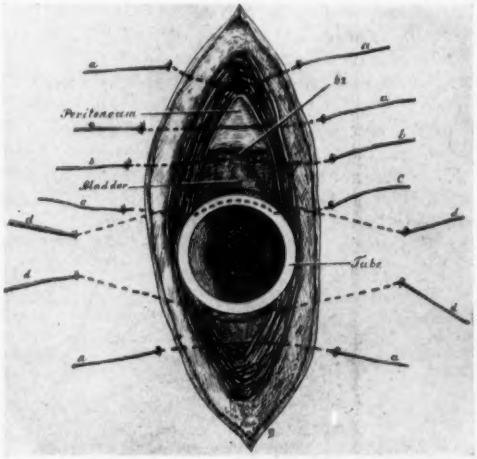


Fig. 10. The tube in position showing, a, through-and-through incision sutures; b, stay and guide suture through bladder; c, suture through tube for holding same; d, traction sutures for closing wound when tube is removed.

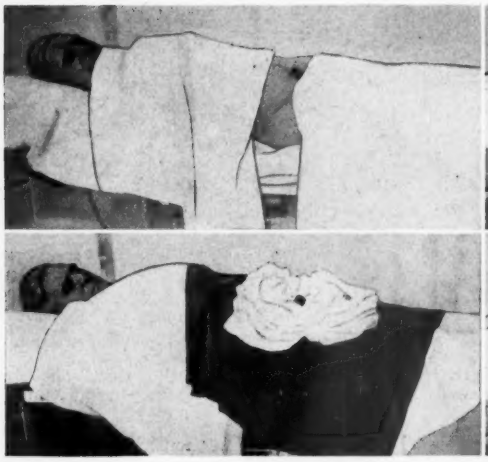


Fig. 11 (above). Showing tube in position after the wound is closed.

Fig. 13. Showing dressings piled high around and about the tube but not on top of it.

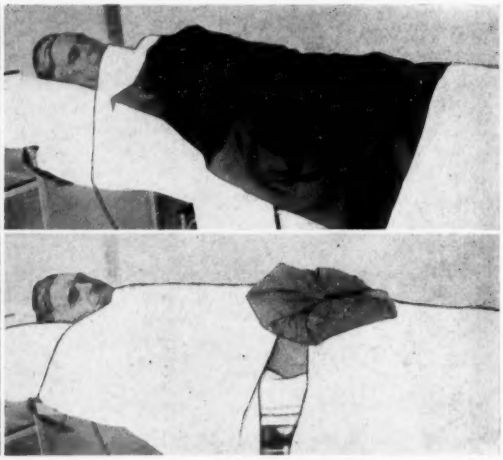


Fig. 12 (above). Piece of dental dam with small slit in center through which drainage tube is passed.

Fig. 14. Dressing in position.

inches long and possess two lateral openings, each ½ (1 cm.) by ¾ inch (2 cm.) (Freyer's drain tube).

The assistant holds the traction stitch lightly and the tube is now inserted through the bladder wound, pushed in far enough so that the bladder-walls will come above the lateral openings (Fig. 9), yet permit the base of the tube to remain some distance from the bottom of the bladder, as illustrated. The object of placing the tube in this position is as follows:

Should any hæmorrhage occur, the blood will gravitate to the base of the bladder and there clot. The bladder walls being held by the stay suture (Fig. 9b) above the lateral openings, the tube will not become clogged, for the supernatant fluid above the clots will pass out through the lateral openings, even should blood-clots accumulate so as to occlude the lower end of the tube. If the tube should become clogged (which it would with a smaller diameter and when placed so as to be in contact with the base of the bladder), tenesmus will occur. This act (tenesmus) opens the prostatic capsule, disturbs the blood-clot formed therein, and hæmorrhage continues and is aggravated. Remember, therefore, it is the diameter of the tube, combined with the position thereof, which prevents the post-operative hæmorrhage, especially should the prostatic plexus be injured or traumatized.

The tube in position, two or three silkworm-gut sutures, according to the size of the wound, are passed completely through skin, muscle, and fascia, to close the incision (Fig. 10a). One of these is passed through the tube to hold it in position (Fig. 10c). In addition, there are two silkworm-gut sutures similarly inserted each side of the tube, one passing above and one below the

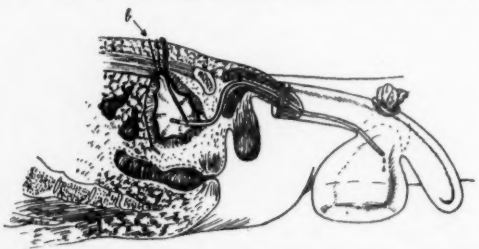


Fig. 15. Showing catheter inserted through urethra in front of the lateral opening.

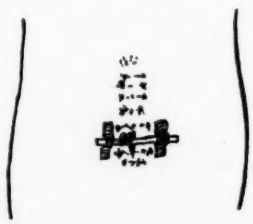


Fig. 16. Thread attached to glass rod which rests across wound.

tube, but farther from the edge of the wound (Fig. 10d). These sutures we term traction sutures, and their use will be explained later. The stay suture (Figs. 10b and 9b) is now threaded on each end and likewise passed through the fascia, muscle, and skin to the surface and is first tied. Tying this suture makes the bladder-wall tense, bringing the cut surfaces of the wall so close about the drainage tube as to prevent leakage and necessitate no other stitches to close same. The remaining stitches are now tied, except the two traction sutures (Fig. 10d), the ends of which are left long and tied together.

Hot water is poured through the tube to see that there is no hæmorrhage and to remove blood-clots. The wound stitches and the skin surface about the tube being covered with a compound tincture of benzoin, the following dressing, suggested by experience in the dentist's chair, is applied:

Piece of dental dam, 24 by 24 inches, with a small slit in the center, through which is passed the drainage tube, as illustrated in Figs. 11 and 12, and the dressings applied, as shown in Figs. 13 and 14, care being taken to pile dressings high around and about tube, but not on top of same. This dressing keeps the patient and bed dry and also serves as a trough; by elevating one side of the dam and placing a basin at the other the bladder can be irrigated easily without soiling the bed.

The after-treatment, which I will not discuss, is practically irrigation every four hours until there is no evidence of even slight bleeding, which is usually within twelve to twenty-four hours. When the bleeding stops the tube is removed. On the third day a catheter, on a Guyon catheter guide, is inserted through the urethra, up through the wound, the end cut off, and a No. 8 silk or linen thread passed through the same just in front of the lateral opening (Fig. 15). The catheter is now pulled out through the urethra until it assumes a suspended position in the bladder like that of the suprapubic tube, in this way preventing clogging or tenesmus, yet giving free drainage because elevated above the floor of bladder. The thread is then attached to the glass rod which rests across wound (Fig. 16), and the traction sutures tied, pulling the edges of the wound close together.

We have found that this has proved a very comfortable and easily applied form of retention catheter after prostatectomy, as well as being aseptic, inasmuch as the meatus can be thoroughly wrapped with moist boracic-acid dressings, the penis pulled back over the catheter and the same cleaned, urethral irritation and urethritis being thus prevented.

One more word about the retention of the stay suture. As will be noted, it pulls the bladder-wall close to the abdominal wall (Fig. 15b) and in so doing elevates the floor of the bladder and maintains it in this position — a fact, I believe, that aids an attenuated, sacculated, or trabecular bladder more quickly to recover its tone, as it brings the floor of the bladder on a level with the mouth, and gravity aids in drainage.

As prostatectomy is an operation that will restore essential physiological activity, relieve intense suffering, and should have a very low mortality (less than one per cent), not only from a utilitarian standpoint, but from a humanitarian point of view, it becomes the specialist's duty to evolve a method of procedure that will give a high percentage of cures and a low percentage of mortality. These percentages can be obtained in proportion to the simplicity of the operation.

Based on numerous cases, extending over fourteen years, with this object in view, and acknowledging the pioneer work of Freyer, this simple technique has been evolved and is presented in the belief that any surgeon with general surgical ability and experience can perform this operation successfully with one assistant in any community, thus increasing the frequency with which this operation is undertaken and proportionately relieving human suffering.

GOITER OPERATIONS WITH SIMPLIFIED TECHNIQUE[1]

By ARTHUR E. BENJAMIN, M.D., Minneapolis, Minnesota

THE technique of operations for goiter has not been modified by surgeons, in general, for a number of years. It is now quite universally conceded by the profession that the best results, in the treatment of the majority of goiters, are obtained by surgical means. Most operators have adopted the technique of certain well-known operators for this disease, such as Kocher, Mayo, Berry, and Crile. There have been but few individual departures from such

[1] Read at the Minnesota Academy of Medicine, February 3, 1915.

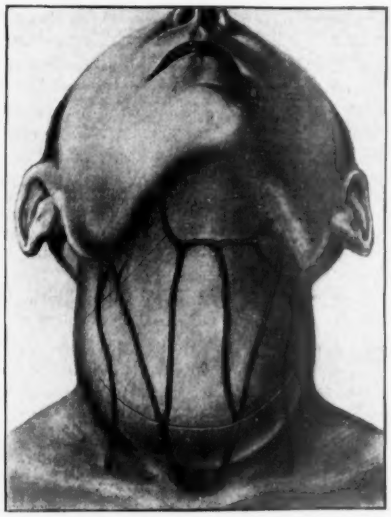


Fig. 1. The low-collar incision for goiter.

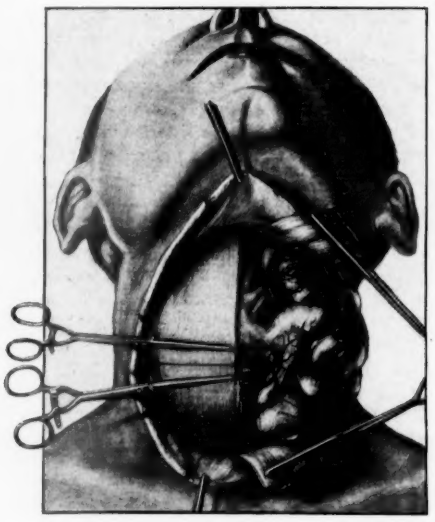


Fig. 2. Flexible forceps clamping fascia and muscles exposing enlarged thyroid.

operative plans. Articles have appeared describing the technique, notably among which are those by Mayo, Berry, Kocher, Balfour, Crile, Kausch, and Mikulicz.

The operation in competent hands is now quite safe in simple goiters, but it seems that there should be some improvement in the technique in order to make them more simple, and to take into consideration the appearance and symmetry of the neck after the operation, as well as the avoidance of possible further trouble.

Many patients do not come to the surgeon for the relief of general symptoms but for the purpose of avoiding mechanical obstruction to the trachea or because of the enlargement and ugly appearance of the neck on account of the growth.

The writer has worked for a number of years trying to perfect a type of operation which would be safe, simple, and satisfactory, and which would bring about a greater percentage of permanent cures, as well as add to the appearance of the patient's neck after operation.

The operation previously described in surgical literature such as the Mikulicz resection is not altogether new and is particularly applicable in the group of cases where there is more or less enlargement of both lobes, either of the cystic, colloid, or adenomatous type. It is this operation which I have attempted to modify and elaborate in my work, and report in this paper.

The Kocher incision is often practiced in Europe, but the low-collar incision has been quite generally adopted by American surgeons; it gives a better exposure of the two lobes of the gland and is capable of being easily extended.

In witnessing the usual operation for goiter and viewing such work from a critical standpoint, one is at once struck with the great number of forceps which seem to be necessary to control hæmorrhage. The application of these forceps and the subsequent tying of ligatures around the clamped blood-vessels consumes time. The numerous forceps employed are in the way and interfere with the work, the operator having to change their location or reapply them in order to proceed with the operation.

There is frequently an incomplete exposure of the gland and therefore some difficulty in controlling hæmorrhage and in removing all of the diseased portion or a sufficient amount of the gland, and, in some instances, overlooking the retrotracheal or other portion abnormally located.

The possible insecurity of ligatures that are applied just above the bite of the artery forceps has always appeared to me as a probable cause of post-operative hæmorrhage. It was therefore thought best to substitute a more safe and positive method of securing the blood-vessels.

The disturbed symmetry of the neck after many operations is not pleasing to the eye, nor does it favor the mental quietude of that patient whose sense of beauty is paramount.

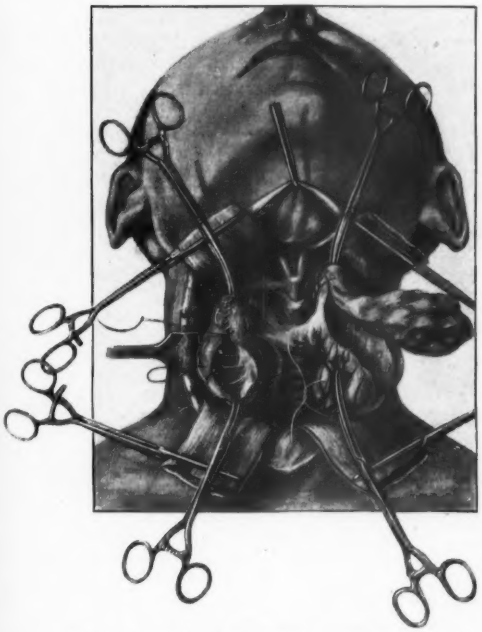


Fig. 3. Four flexible clamps controlling blood supply of thyroid. Diseased portion of thyroid being removed on left. The approximation of the remaining portion of gland and capsule on the right side.

DESCRIPTION OF OPERATION

A low-collar or transverse incision is made extending across the neck, equally distant from the midline. In this incision the skin, cutaneous nerves, and anterior external or possibly posterior external jugular veins and the platysma are severed, and in this manner two flaps are produced which are dissected from the underlying fascia, one upward and the other downward, so as to be able to expose thoroughly the area involved by the enlarged thyroid, as shown in Fig. 1.

The beveled skin incision perhaps produces less of a scar when properly approximated than the ordinary perpendicular incision through the skin. The sternohyoid and sternothyroid muscles are separated by a midline blunt dissection from the opposite pair down to the sternum and up to the thyroid cartilage. The index finger is then passed beneath these muscles on either side, exploring the gland so as to determine the size of the lobes, separating them from the overlying tissue.

To the outer border of one lobe, a puncture is made through the fascia outside of the sternohyoid and sternothyroid and at times even beyond the sternocleidomastoid, in large deep-seated goiters where it is necessary to have a considerable amount of room. This puncture is made on a higher level than the skin incision, opposite the center of the growth.

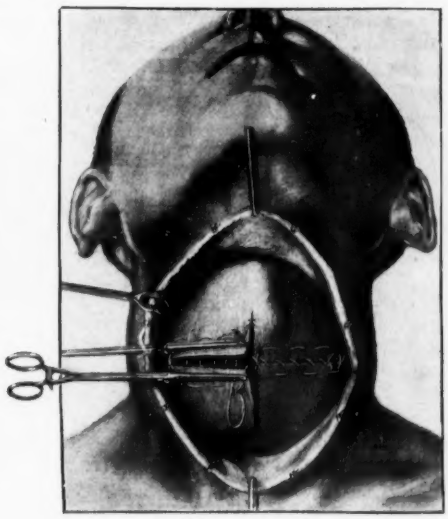


Fig. 4. Approximation of sternohyoid and sternothyroid fibers and fascia.

Fig. 5. Upper line showing (through skin), closure of muscles. Lower line closure of skin; tube in position.

Through this opening two rough-jawed forceps of a flexible character are applied to the center of the neck with the handles outward. These are clamped on to the fascia and muscle-tissue, including the portion intervening between the puncture and the center of the neck. The fascia and the muscles between these forceps are severed, and the flaps made thereby are turned upward and downward, rolling them away from over the growth, as illustrated in Fig. 2.

A similar exposure of the opposite lobe is made. The gland is so completely exposed that the balance of the operative work is comparatively simple and easy, as no forceps will be in the way and the diseased tissue is quite accessible. The thin membrane-like capsule which surrounds the thyroid is now separated and each separate lobe brought up from its bed on either side of the trachea, in order to plan the removal of the excess of gland substance, or the diseased portions, in such a way that the remaining portions are nearly equal in size, and, therefore, the neck symmetrical. When this is done, four flexible-jawed forceps (non-slipping) are clamped over the four respective main blood-vessels, including some of the gland substance at each pole, or by placing two on the side to be first removed and the other two forceps just before the second side is attacked.

An elliptical incision is now made through the capsule of sufficient size to get at the diseased or enlarged tissue beneath, the incision beginning at the upper pole and extending downward, a little anterior to the outer border, to the lower pole, extending upward and posterior to the point of beginning. A shelling-out process is now begun with the finger or suitable dull dissector or spoon, removing all of the diseased interior of the gland or that portion of it which is necessary. This is sometimes accomplished in certain types of goiter by removing a wedge-shaped piece of the parenchyma.

In this way the best of the secreting portion of the gland, next to the capsule, is allowed to remain. The parathyroids are avoided as well as the recurrent laryngeal nerve; the capsule makes a firm tissue through which to pass the controlling sutures.

Plain double No. 2 catgut sutures are passed just over one of the forceps controlling the blood supply and tied and continued back and forth through the sides of the remaining portion of the gland and capsule. The blood supply is controlled by a suture of the other pole, the forceps being removed as the ties are made. Over-and-over suture, continuous, completes the gap (Fig. 3).

A similar process is begun on the opposite lobe, with an idea of symmetry in mind, as far as is consistent with the removal of sufficient gland tissue or all of the diseased substance. When the two lobes have been operated upon and properly sutured, the appearance of the remaining gland substance approaches nearly the normal in amount.

When it is found necessary on account of disease of the isthmus to remove a portion, it can be done very easily after or before the work on the lobes has been completed.

When the gland has been operated upon, the muscles and fascia are brought in apposition by making a continuous Halstead suture of plain catgut No. 2 in a manner as illustrated in Fig. 4. These sutures are placed a little distance from the cut ends, including all of the muscle layers and fascia, which insures against retraction of muscle-tissue.

When the fascia is not dissected therefrom, it makes a better contact surface for the suture, preventing any cutting through of sutures in the muscle tissue with consequent retraction and subsequent irregularity of contour and scarring of the neck. The fascia and muscle borders are then brought more closely and accurately in apposition by a continuous No. 1 chromic catgut suture, the deeper layer being with plain catgut, which absorbs early, allowing the tissue to straighten out properly in sufficient time to overcome "puckering." Any blood-vessels not definitely controlled by these two suture lines can be secured individually, but seldom will it be necessary to ligate any except the external and anterior jugular veins.

The sternothyroid and sternohyoid muscles may now be brought loosely together in the central line over the trachea with plain catgut, leaving an opening for a small drain below to favor exit of serum and blood from the field of operation. This is found necessary in operations of every type for goiter. I bring this drain out through the center of the low-collar incision.

The wound is then closed by first approximating the fat and platysma layer with continuous fine chromic catgut and the skin with No. 1 20-day chromic, subcutaneously applied (Fig. 5). A snug-fitting bandage prevents oozing and favors union of approximated tissue.

TREATMENT OF FRACTURES BY AUTOGENOUS BONE TRANSPLANTS

By FREDERICK G. DYAS, M.D., F.A.C.S., Chicago

THE purpose of this paper is to compare various methods at present employed in the open treatment of fractures in relation to the indications for their use. The history of the development of operative technique has apparently followed a rather definite plan in almost every field; e.g., first, the use of non-absorbable substances, and later, as the physiology and pathology of the tissue were better understood, the gradual substitution of other methods and the abandonment of the foreign body.

Possibly the earliest illustration of this is the use of the non-absorbable ligature of silk or linen, and sometimes even of wire. Many of us still remember the attempts to avoid the use of these materials, which acted as foreign bodies tending to produce infection and post-operative hernia, by the use of the angiotribe. The highly efficient catgut ligature has been substituted for this instrument and the operative wound is now permanently closed at the end of the operation.

Similarly, we all remember the use of non-absorbable plates to fill up defects in the skull after fractures of the vault, the patient frequently being obliged to submit to a second operation for the removal of the plate because of the cortical irritation resulting from its presence, and because of its reaction to extremes of temperature, frequently incapacitating the patient from all active work. Skull defects are now either repaired by replacing fragments of bone or allowed to remain with only the soft parts as a covering to the brain, the gap being partially filled in after a time by the growth of bone from the margin, the dense connective tissue providing a sufficient protection to the brain. The results obtained by the latter method are always superior to those obtained by the introduction of a foreign non-absorbable body.

The employment of foreign bodies in abdominal surgery, such as the anastomosis button, the bone bobbin, or the rubber ligature of McGraw in gastro-enterostomy, have been almost entirely abandoned in favor of the suture method, as experience has shown that these devices frequently act as irritating foreign bodies giving rise to symptoms which often necessitate their removal by a subsequent operation.

Every operator dreads the possibility of leaving a sponge in the peritoneal cavity. The long train of symptoms which follows such a tragedy, as the patient always grows worse, necessitates the subsequent reopening of the abdomen as the only source of relief, while the unhappy surgeon is confronted with loss of prestige, if not with litigation.

It is a matter of every day observation that the peritoneum will withstand a considerable amount of infection if no foreign substance is present.

The metal filagree formerly used in the repair of large ventral hernias has given way to the radical cure by means of the imbrication of the fascia secured by suture.

These instances prove the statement made earlier in this paper, that foreign bodies are not well tolerated by the tissues and have, one by one, been replaced by methods of simpler technique not involving the introduction of irritating substances into the tissues. Many more examples might be given to substantiate this contention.

The instrumental technique as developed by Sir Arbuthnot Lane, and made necessary by the application of the steel plate to the fragments of a bone after reduction of a fracture, only emphasizes the fact that the smallest amount of a non-virulent infection will not be tolerated by the tissues in the presence of a foreign body.

The result of a non-absorbable foreign body, plus infection, in the tissues always means suppuration, necessitating the removal of the foreign body. When this occurs at the seat of fracture in bones, non-union results, and chronic osteomyelitis may be the ultimate outcome.

The open treatment of fractures may be undertaken with the same fearlessness and with the same assurance of success as operations in the peritoneal cavity, provided no non-absorbable substances are used. There are many different methods by which this may be accomplished: viz.,

1. By the autogenous intramedullary bone transplant — which is perhaps the simplest — removed from the crest of the tibia or a portion of the shaft of the fibula when that bone is fractured.

2. By the autogenous inlay of Albee, which is possibly the most scientific procedure because it brings similar histologic structures into contact;

Fig. 1.

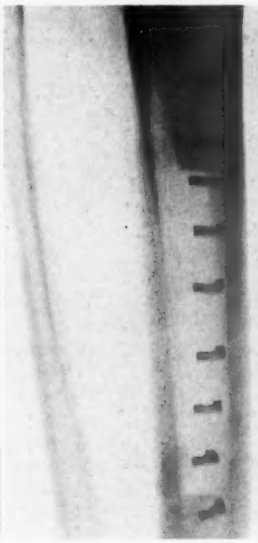


Fig. 1A.

Fig. 2.

Figs. 1 and 1A, Case 1. Defect after removal of graft. Fracture occurred here after two weeks.

Fig. 2. Intramedullary graft from opposite tibia, Case 1.

viz., cortex to cortex and cancellous tissue to cancellous tissue.

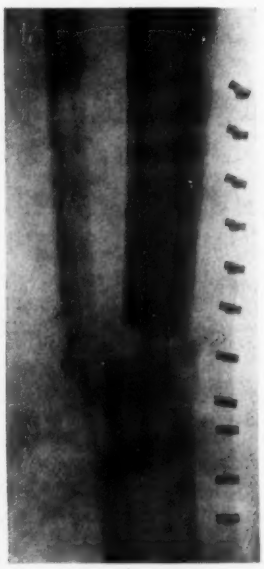


Fig. 3. Intramedullary graft from opposite tibia, Case 2.

3. By bone pegs.
4. By ivory pegs.
5. By sutures of kangaroo tendon or chromic catgut.

The handling of the fractured ends of the bone in the open wound during the manipulations necessary for the reduction of the displacement, and the preparation of the fragments for the introduction of the transplant, under ordinary aseptic precautions is as free from hazard to the part as is the handling of the bowel during a laparotomy. The technical difficulties are not as great as in the application of the plate, and the duration of the operation is no longer.

It must be said that absorption of a portion of the shaft of the tibia may take place after the removal of the transplant from its crest, as happened in Case 1 of our series, resulting as it did in a fracture at that point from an insignificant trauma, but this is no contra-indication to the use of this method. The sense of security enjoyed by the operator after the use of the autogenous transplant as a method of fixation cannot be overestimated. This happy state of mind is rarely experienced after the use of the plate, for time has shown that even in the hands of the most experienced operator, and amidst the most ideal surroundings, infection sooner or later is the rule. This, of course, is not in har-

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 4. Case 3.

Fig. 5, Case 3. Defect in fibula. Fragment of fibula used for intramedullary splint.

Fig. 6, Case 3.

Fig. 7, Case 3. Defect from removal of splint. Transplant from crest of tibia.

mony with the results of Lane, who rarely, if ever, gets an infection; but for the operator who must have the simplest method of fragment fixation with the minimum hazard of infection, or with infection inevitably introduced, who must provide a means by which the infected tissues will not be devitalized and succumb to the infection, the autogenous transplant offers the best chance.

The non-absorbable foreign body must disappear from general use in bone surgery, just as it has from the surgery of other tissues.

I believe it safe to say that the man who has once used the bone transplant will never return to the metal plate as a means of fixation. Elaborate instruments are not necessary, but a good motor with saws and reamers is helpful. Our first case was done with a hand-saw, chisel and mallet, and bone curette.

It is true that metal devices have their place in the treatment of certain fractures, but the employment of non-absorbable substances is becoming more and more limited. The results obtained in our work with the autogenous bone transplants are set forth in the following case histories and illustrations:

Case 1. J. G., age 54. On June 15, 1914, the patient sustained a fracture of the right leg at about the junction of the lower and middle thirds, and was taken to Cook County Hospital. A skiagram showed an overriding of the fragments of the tibia of about an inch and a half. It was impossible to reduce the fragments under ether anæsthesia. Six weeks later there was no attempt at union and no callus.

On July 28, 1914, the patient was put to sleep and after preparing the injured limb with tincture of iodine two parts, glycerine one part, an incision was made over the crest of the tibia for about eight inches. The fragments were sharply angulated and thrust through the incision. With a Gigli saw a portion of the rough fragments was sawed away. The rest was smoothed off with a bone-biting forceps. The medulla was reamed out with a sharp curette and the wound covered with gauze.

The opposite limb was prepared in the usual way and an incision for about six inches made over the crest of the sound tibia. A portion of bone was removed by sawing the tibia about its middle and at a point four inches from that lower down, the portion included between the two saw cuts being removed with a broad chisel. This was removed without the periosteum. The wound was then closed, using catgut stitches for the periosteum and skin clips for the skin.

After trimming up our bone peg it was firmly driven into the medullary cavity of the upper fragment with the two ends of the broken bone thrust through the skin. Then, as the fragments were brought into alignment, the lower fragment received the protruding inch and a half of the bone peg, making a very firm union and holding the fragments in exact apposition and alignment. The periosteum was closed with catgut and the skin with skin clips. A posterior molded plaster of Paris case was applied.

Two weeks later the patient fell and fractured the leg from which the splint had been removed. This was a green stick fracture and occurred in the area between the two transverse saw cuts. There was no displacement of the fragments and the fracture was not compounded. The leg was placed immediately in a cast and union took place after five weeks. The patient now is able to move about comfortably and has a strong leg on either side.

CASE 2. A. L., age 30, came under observation November 10, 1914. Two months previously the patient suffered a compound fracture of the left tibia in the lower third. There was never any attempt at bony union, although apposition seemed to be good. It has always been possible to move the fragments around in any position.

A linear incision five inches long was made over the site of the fracture at about the junction of the lower and middle thirds. The periosteum was removed with a periosteome and the fractured ends of the bone were pushed through the incision. The connective tissue was cut away and the ends of the bone freshened by means of a saw, removing a small disc from each fragment. By means of the reamer the medullary cavity of the upper fragment was reamed out for a distance of three inches, making a cavity half an inch in diameter. The medullary cavity of the lower fragment was reamed out for about two inches. The bones were then placed in apposition and the wound covered with gauze. An incision was then made over the opposite tibia, the periosteum removed, and by means of a circular saw, driven by a motor, a bone splint, measuring four inches by one-half inch, was removed from the crest of the tibia.

This was trimmed off by means of the saw and introduced into the medullary cavity of the upper fragment for a distance of two and a half inches. The lower portion was found to be too long and was shortened about half an inch, and then introduced into the medullary cavity of the lower fragment. In the process of the introduction of this bone splint the lower fragment was fractured, a portion being split off communicating with the medullary cavity. This was held in place, however, by means of a thick strand of kangaroo tendon wound around the fractured portion of the fragment as an axe handle is wound. The fragments were then brought into close apposition, the fascia sewed with catgut, and the skin held by skin clips. A plaster of Paris cast was applied reaching from the perineum to the web of the toes, with the foot at right angles to the leg.

The work with the reamer and saw was done by Dr. Emil Hoaglund, who used his electric motor and appliances.

CASE 3. M. O., male, age 28, was first seen at Joliet, Illinois, on December 4. About two months before, the patient had suffered a compound comminuted fracture of both bones of both legs in a runaway accident. He was taken to St. Joseph's Hospital and an attempt was made to reduce the fragments. The compound wounds were treated aseptically and healed kindly. As there was considerable displacement of the fragments and no attempt at bony union, open operation was decided upon and done on December 4, 1914, at St. Joseph's Hospital, Joliet. An incision over the fracture of the right leg was made for about eight inches, and the fractured ends of the bone were pushed through the skin incision, including the fragments. The sharp, irregular ends of the fragments were sawed off squarely by means of a handsaw. A portion of the fractured fibula about three inches long was then removed; this portion of the fibula was introduced into the medullary cavity of the upper fragment.

The medullary cavity of the lower fragment was then reamed out with the burr and, by exerting traction on the lower fragment, it was possible to introduce the protruding portion of the bone plug into the lower fragment. This brought the two fragments into close apposition and perfect anatomical relationship. The Esmarch bandage was removed before the incision was closed, the bleeding points ligated, the periosteum and fascia closed by catgut and the skin by interrupted silkworm-gut sutures.

An incision was now made over the fractured left tibia, extending for about ten inches. The fragments were pushed through the skin incision and sawed off as previously by means of the handsaw, so as to get square apposition. As the fibula was not readily available in this case, an intramedullary splint was made by making two crosscuts over the crest of the tibia and uniting these crosscuts by means of a longitudinal incision through the bone made by the circular saw. This gave us a bone splint about three inches long by a third of an inch in diameter. The medullary cavity of the fragments was then reamed out by the burr, the plug first introduced into the upper fragment and then, by exerting traction and manipulation, the protruding part of the plug was received into the medullary cavity of the lower fragment. The Esmarch bandage was removed and bleeding points ligated. The periosteum and fascia were closed by catgut and the skin by interrupted silkworm-gut sutures.

A plaster cast was now applied to each leg, reaching from well up on the hip to the web of the toes, the foot being held at right angles to the leg, the great toe, the inner surface of the patella and the anterior superior spine of the ilium being in a line. This was done on both sides after protecting the soft tissues by dressings over the incisions and sheet wadding along the rest of the limb.

The motor, saws, and burrs were supplied by Dr. Emil Hoaglund.

Dr. Charles Davison, of Chicago, who has operated upon a number of these cases, advises placing both legs in casts for four to five weeks following the operation. He has followed this practice in his own work, and in a recent conversation with him he said that he had no fractures following the removal of the bone peg.

In all probability there is a bone absorption at the site of the removal of the splint, causing considerable weakness of the tibia at this point. The suggestion has been made by Dr. Davison, and recently carried out by him, of using a portion of the fibula upon the injured side for the intramedullary splint. This is a splendid idea and undoubtedly will be much used in the future.

It is very desirable in the performance of this operation to have suitable instruments with which to work. While it may be accomplished by a hand-driven saw and reamer and by a chisel and mallet, the operation is much facilitated, and at times greatly shortened, by having a good motor with which to drive the reamers and the saws. Furthermore, the danger of fracture in the process of removing the bone splint is very greatly reduced because of the lessened trauma of the motor-driven instruments. A number of these are now upon the market.

In none of the cases occurring in our own service, or in others observed in the wards of other men in Cook County Hospital, in which the autogenous bone transplant has been used in the open operation for the fixation of fragments, has any serious infection occurred, and bony union of the fragments so fixed has taken place within the normal time limits for the bone in question.

To summarize:

1. Foreign bodies for the fixation of most fragments in the open treatment of fractures are unnecessary.

2. Non-absorbable material used in the open treatment of fractures predisposes to infection and osteomyelitis, and frequently must be removed.

3. Intramedullary bone transplants, or inlays, will frequently bring about union when foreign bodies have failed to do so.

4. The time of the operation is not increased by the use of the bone transplant.

5. The weakening of the bone from which the splint is removed is not a contra-indication to the operation.

6. The danger of infection is no more of a contra-indication to operations upon bones than upon other tissues when non-absorbable substances are not used for fixation purposes.

TECHNIQUE USED IN APPLYING ANASTOMOTIC BUTTONS

By RICARDO FINOCHIETTO, M.D., Buenos Aires, Argentine

SINCE 1912 we have employed in the creation of neostomies, and especially in the application of anastomotic buttons, a procedure which facilitates the making of the purse-string suture. In each instance we determine definitely, by mathematical rules, the size of the incision to be made in the bowel to receive the button or catheter, and we make the field of operation completely bloodless.

The method consists in pressing between the blades of a hæmostatic forceps a designated portion of the wall of the stomach or intestine. Around the blades of the hæmostat a purse-string suture is inserted. Through the zone pressed together by the hæmostat, an incision is made, and the catheter or button is introduced into the bloodless incision.

TECHNIQUE OF THE APPLICATION OF THE MURPHY BUTTON

First step. With the left hand the operator grasps from the wall of the stomach or intestine, with a Ferrier hæmostatic forceps, a fold perpendicular to the line of future incision. The size of the fold varies with the kind of button to be used. If the cylindrical button is used the amount of stomach-wall or intestine to be grasped by the forceps is equal to three-quarters of the diameter of the button. If the oblong button is used, the size of the fold is equal to one-half the great diameter of the button (Fig. 1). The forceps are completely and slowly shut. The purse-string suture is started at one side of the blades of the forceps. The needle progresses with wave motion going in and coming out of the intestinal walls, taking a stitch of the desired thickness. When the top of the fold is reached, the needle is passed through it, and the suture is continued on the opposite side. After turning around the tip of the forceps, the needle is passed through the top of the fold, on this side, is brought down to the anterior side, and ends in a point near to that at which the suture started.

Second step. The forceps is taken away and we find that the mucous coat in the field, which has been held by the forceps, has disappeared; the

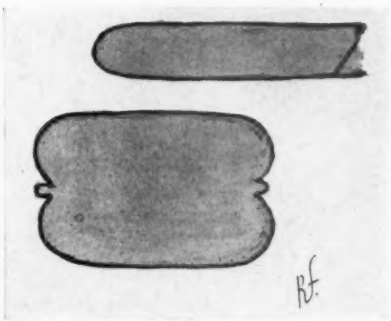


Fig. 1. Showing the size of fold for oblong button.

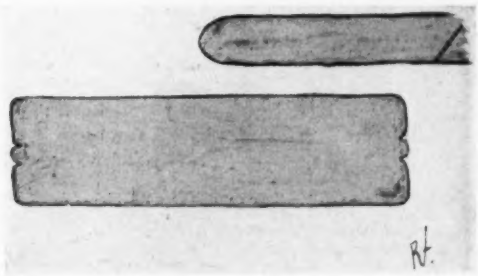


Fig. 2. Showing size of fold for cylindrical button.

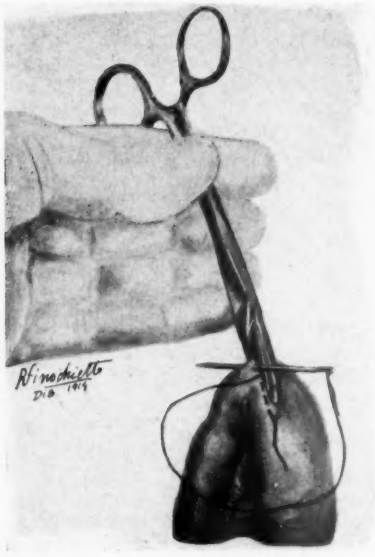


Fig. 3. Intestine grasped by forceps and suture started.

submucous layer with its vessels, together with the seromuscular layers, are found very much reduced. With a cut of the scissors the viscus is opened in the pressed zone. The button is placed and the purse-string suture tied. It is understood that before opening the viscus we

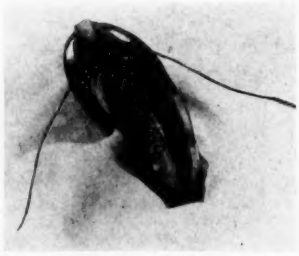


Fig. 4. Button in place and purse-string suture tied.

shall make certain that the bowel has been closed by one of the methods in use. It is of course known that the mucous and submucous layers of the stomach go underneath the seromusculosa with great ease.

In applying the forceps to the stomach, it is necessary that the fingers which take the fold should grasp the gut firmly, since the superficial layers have a tendency to slip from the forceps. Likewise, because of the size of the vessels of the stomach, we are obliged if we require an absolutely bloodless field to leave the forceps in place a few moments longer than would be necessary if we were working in the intestines or in the gallbladder.

This technique is also employed with advantage in jejunostomies and gastrostomies according to Witzel's method; it is also of great advantage in applying tubes or catheters in any segment of the gastro-intestinal tract.

PERINEAL SECTION IN BOYS

By WELLER VAN HOOK, M.D., Chicago

THE necessity of making a perineal opening into the bladder in boys is less frequently met with than in men. Nevertheless, for the removal of small stones and foreign bodies or for the establishment of perineal drainage during the healing period of operations for such conditions as hypospadias, it is a necessity not infrequently encountered.

Several anatomical conditions in boys differing from corresponding conditions in later life render perineal section worthy of thought.

Differences in size are most impressive. Then the differences in development of the bladder, urethra, and all other structures need observation. Figures 1 and 2 are illustrative and suggestive.

Fortunately, the fact that the bladder in young boys is so high and that it is long and narrow is unimportant as long as we are able to pass urethral instruments into the bladder.

We do not really require an especial set of urethral instruments in order to operate in such cases. The boutonnière is made in children as follows:

A suitable sound is passed through the urethra into the bladder. While a special grooved staff would be desirable it is not necessary. It is only a little more trouble to follow the plain than the grooved sound into the bladder from the perineum. For small boys a satisfactory staff may be extemporized by bending with the fingers a silver probe into the form of a urethral sound. If the six-inch surgical probe is not large enough a silver uterine probe may be used.

This probe having been passed into the bladder, the patient being held in the lithotomy position, the perineum is distended gently by an assistant pressing the probe against it from within. To accomplish this the probe must be held strongly in the fingers and must be used like a staff to lift the soft perineal tissues away from the pelvis. The operator can usually feel the probe from the perineum.

Now the operator pushes the blade of a narrow scalpel (or of a cataract knife) into the perineum, beginning at a point from about one-third of an inch in front of the anus for babies, to about one-half an inch in boys of six or eight years. One wishes to cut neither the *sphincter ani* nor the bulb of the urethra (see Fig. 2).

The knife is entered with its back upward and toward the bulb of the urethra, the edge toward the rectum. But the cutting is done at

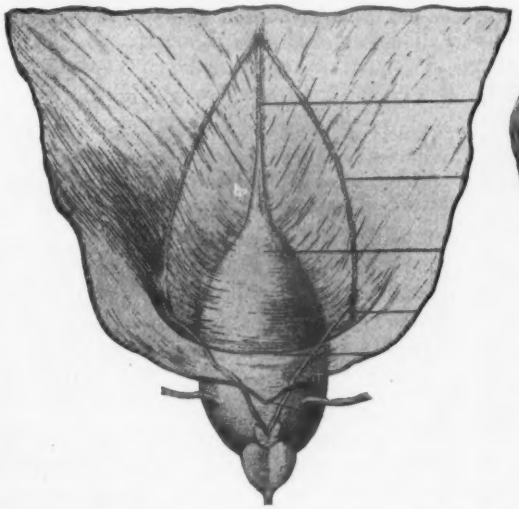


Fig. 1. The bladder, etc., in a young boy. (After Poirier.)

Fig. 2. This figure shows the vesico-urethral anatomy in an infant. (After Merkel-Henle.)

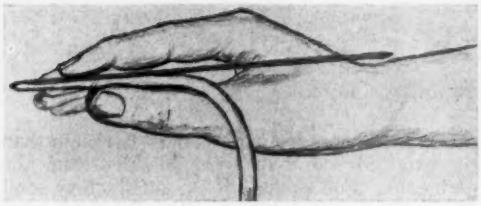


Fig. 3. Illustrating the method of holding the soft catheter.

the point of the instrument. Carefully and steadily the knife is pushed inward until the approximate depth of the probe is reached. If the knife does not contact the probe, the handle of the knife may be moved from side to side while the point makes slight corresponding oscillations in the opposite directions. The hand will then feel the resisting probe through the urethra, the knife-point lying within the loose areolar tissue about the urethra. When the probe is felt in this way the knife may be gently withdrawn for a slight distance and its point turned carefully toward the sound, then pressed on until it enters the urethra and grates upon the silver. Now the operator pushes forward the knife-point within the urethra until a generous incision is made in the tube. No fear need be entertained as to the future integrity of the urethra; the longitudinal cut heals swiftly when the tube is removed.

The next step consists in passing into the bladder a grooved director by the side of the knife-blade. The operator holds the handle of the knife in his left hand and, with his right hand, passes the grooved director along the knife-blade until he feels the probe in the urethra. This means that the point of the grooved director is in the urethra. It is next pushed on until it is in the bladder.

Remember that when a grooved or hollow instrument enters the bladder, urine flows, unless of course there is total absence of urine or the presence of blood-clots prevents. The importance of remembering this simple rule during the heat of an operation is not to be overestimated. Even if the bladder has been emptied only a few minutes before, almost invariably enough urine will have been poured into the organ to give the diagnostic discharge.

It is now the moment to withdraw the knife and the urethral staff leaving the grooved director in place. And it remains only to push the catheter on into the bladder. This maneuver is most neatly accomplished as follows:

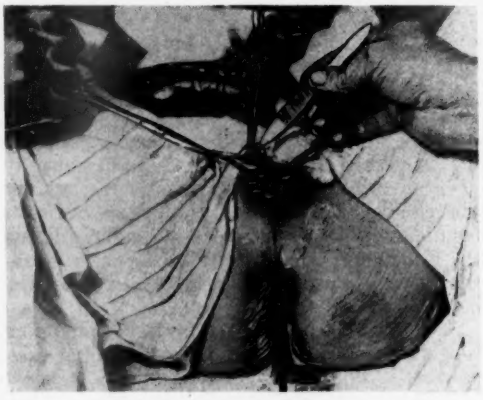


Fig. 4. This shows a catheter introduced as a preliminary to an operation for hypospadias.

Prepare a small, perfectly new, soft and smooth Nélaton's catheter by digging with the point of a penknife a small hollow within the solid tip of the instrument. While the catheter is held firmly in one hand the blunt end of a firm probe may be engaged in this hollow. Now the catheter being pulled back taut upon the probe, the tube and the probe may be held in the right hand *as one apparatus*. The probe makes the catheter a rigid instead of a flabby and loose instrument. Figure 3 shows how the device is held.

Next pass the point of the catheter thus supported along the grooved director until it is in the bladder. If desired, a little salt solution may be injected into the organ through the catheter to make sure that the drainage is perfect. If the discharge is not free the catheter is to be pushed farther in or drawn out a little until the right point is reached.

The operation ends by the passing of a strong silkworm-gut suture deeply through the skin at the side of the wound through almost one-half the thickness of the catheter. The suture should be made secure by the tying of three knots.

For children the best dressing is of gauze and a heavy layer of stiff zinc oxide ointment applied freely about the wound.

Figure 4 shows the catheter in position preliminary to operation on a case of hypospadias in a six-year-old boy.

ACUTE PYELITIS: ITS DIAGNOSIS AND TREATMENT

By KENNETH H. AYNESWORTH, M.D., F.A.C.S., Waco, Texas

THE literature of acute pyelitis has been rather rich during the past few years, and one finds quite a number of good articles bearing upon this subject. The literature prior to the general use of the cystoscope and the ureteral catheter is of very little value, as the methods of diagnosis then in use were necessarily quite inaccurate and often misleading. It seems proper that the term pyelitis should mean inflammation of the pelvis of the kidney and the upper part of the ureter. This inflammation, or, more accurately, the reaction from inflammation of the pelvis of the kidney, is somewhat different from inflammation elsewhere in the body. In other regions of the body inflammation almost invariably induces a local reaction, which is one of the chief aids in diagnosis. It has been my experience that acute pyelitis is rarely diagnosed correctly unless it be of a very acute type with sufficient suppuration to form small lumps of pus, which thus mechanically block the ureter or cause swelling of the mucous membrane, which starts symptoms of ureteral obstruction, or else the inflammation must be so grave as to involve the kidney substance and superinduce symptoms of acute nephritis with local pain and soreness.

The pathology of acute pyelitis is well understood, and a description is not necessary in this paper; no distinctions will be attempted between pyelitis and pyelonephritis, as the discussion has merely academic interest; neither will pyelitis from stones, kidney inflammations, etc., be discussed, as the title of the paper includes only the type usually described as acute pyelitis.

The etiology of pyelitis is the same as for any other inflammation, but the mode of its origin is very different and is worthy of careful study. Bacteriological studies have conclusively demonstrated that the principal organism of infection is the colon bacillus. This germ produces the great majority of the infections, and general observation shows it present in pure culture quite often. The other pus-forming organisms, such as the staphylococcus, the streptococcus, the pneumococcus, and the bacillus of influenza, may be found in conjunction with the colon bacillus, or in some rare instances they may be the only organism present in an infection. In my experience the colon bacillus has always been present either in pure culture or in association with one or more of the other pus-producing organisms. The typhoid bacillus may be the only germ present, but this is extremely rare. In cases which become chronic the colon bacillus is nearly always the only germ present, due in all probability to the fact that it tends to overgrow and crowd out other germs of less viability.

Many explanations have been given for the frequent solitary presence of the colon bacillus and for its presence with other organisms. This seems to indicate that the infection most probably comes from the intestinal tract, either directly or indirectly. Some writers, especially Weibel (1), claim that the infections by the staphylococcus and streptococcus are ascending infections and that the colon-bacillus infections are from the intestines. This explanation should be given considerable weight, for it would clarify the situation somewhat. Pathologists have classified the routes of infections into ascending, descending, and hæmatogenous infections, and those from contiguous infected tissues. Kelly (2) ascribes the great majority to hæmatogenous infection. It is quite difficult to believe this statement unless one accepts the possibility that the tissues of the pelvis of the kidney have a susceptibility to the colon bacillus; otherwise there would be many localized areas of colon-bacillus infection in different parts of the body, which we know is not the case. Weibel's (1) explanation seems most plausible: he says that there is a direct lymphatic connection between the lymphatics of the cæcum and the ascending colon with those of the kidney, and that organisms can and do easily follow these paths to the pelvis of the kidney and there induce an infection. We know that many cases of pyelitis give a previous history of chronic constipation, and often attacks of colon involvement have occurred just prior to the onset of pyelitis. Anything which will lower the local resistance will be a factor in making the tissues more susceptible to infection. The patients whom I have studied gave no previous history of diagnostic value, except those patients in whom local traumatisms have been a factor. The enlarging pregnant uterus has been accused of being the cause on account of pressure on the ureter stopping the normal flow of urine and producing lowered vitality, thus making the tissues more vulnerable. If this were true, why have we not more pregnant patients with acute

pyelitis? If this were a factor of much weight there would be innumerale patients with this disease in every section of the country — which we all know is not the case. Then, too, why is not every patient with massive fibroids or large ovarian cysts afflicted with acute pyelitis? I have not seen such a case, and I am sure that if pressure were a real factor our patients with large fibroids would have acute pyelitis in a larger percentage than those without it. The cases of acute pyelitis of pregnancy which I have treated were in the early months of pregnancy, when the uterus was not at all a factor in abdominal pressure.

Infections elsewhere in the body might be strongly suspected of causing infections of the pelvis through the blood stream. I am sure that the previous history of some of my patients would lend support to this theory. One will be reported in detail later on. Anything which tends to block the flow of urine through the normal channel and to produce a damming up of the urine will lower the local resistance and thereby constitute a real factor in the pathology of this disease; but my experience does not bear out this contention, as the majority of my patients had no interference with the urinary outflow. Of course, in old prostatics with urinary retention and in women with marked cystocele there are contributing factors which must be considered in discussing this subject, but entirely too much weight has been placed upon these conditions. I do not know why the pelvis of the kidney is so often affected; neither do I know why the pharynx or the conjunctiva is likewise often involved in inflammation. I am of the opinion that associated conditions are often described as causes. However, we do know that the pelvis is frequently involved in otherwise perfectly healthy individuals and that almost everyone is subject to some one of the various things which have been suspected as being the cause of pyelitis; these conditions can have value only when a causative relationship can be established with some degree of certainty. We know that, in many infections, germs which have come from the kidney are found in the urine direct, and yet there is not a suspicion of pyelitis. These organisms must either come from the blood through the kidney or else get into the urinary tract somewhere else, and yet there is no infection

Symptomatology of acute pyelitis is exceedingly interesting. In no other inflammation with which I am familiar is there such unusual phenomena of reflex symptomatology. Only with the rarest exceptions have I heard patients complain of any local pain or disturbance of any kind. Of course, in those patients in whom there is involvement of the kidney substance, or some blocking of the urinary outflow, or some local injury, there is always local symptomatology. In those patients who give no local manifestations the symptoms are those of a general infection associated with frequent urination and irritable bladder. Practically every case has been diagnosed cystitis as a complication of some acute infection rather than the correct diagnosis of simple acute pyelitis. The reaction to infection, as shown by fever, rapid pulse, often chills or chilly sensations, general body aching, sometimes nausea and vomiting, are among the usual symptoms of acute pyelitis; the regional symptoms, as pertaining to the genito-urinary tract, are frequent urination with painful or at least unpleasant sensations. Some patients do not have painful urination, especially at the beginning of the attack; others suffer from the very onset of the disease. The examination of the urine will show the determinative factors to be pus, kidney epithelia, serum albumin, casts (only when the kidney is involved), generally an acid urine, and often red blood-cells. The specific gravity is frequently low, due to the larger quantity of urine secreted in this condition. There is an absence of the usual bladder epithelia seen in such abundance in cystitis. I have seen frequent and painful urination some time before pus was found in the urine.

The most violent cases I have seen have been in pregnant women in whom the onset was rather sudden, with chills, high fever, local pain, and marked urinary distress. On the other hand, I have seen patients treated for typhoid fever and puerperal sepsis who had pyelitis with continuous fever of remittent type. Undetermined fever in children should arouse the suspicion of pyelitis when the other usual diseases have been excluded. R. G. Freeman (3) says that in children fever may or may not be present and that cases do occur without fever at any time. Vanderhoof (5) has written a very valuable article on pseudomalarial types of pyelitis; i.e., cases of pyelitis which have been diagnosed malaria on account of their intermittent type of fever. Since the use of the cystoscope and the ureteral catheter has become general, no case of undetermined infection with purulent urine should go without a most careful examination for the presence of pyelitis. Since I have made it a rule to cystocsope all cases with purulent urine, the diagnosis of pyelitis has practically superseded that of cystitis.

Treatment, in order to be efficient, must follow accurate diagnosis. Formerly there was much difference of opinion as to what was advisable in patients presenting symptoms of cystitis; when the urine was acid it was the usual advice to give some form of alkaline treatment; when it was alkaline the advice was to give acid treatment. We now know that there may be a cystitis with either acid or alkaline urine, and a pyelitis with acid or alkaline urine, and that before anything is done the exact facts must be known. In colon-bacillus infections the urine is practically always acid; in other infections the urine may or may not be acid; often it is alkaline. The indications are to give some acid-forming drug to maintain, if possible, the acidity. The formaldehyde eliminating compounds have given the best service.

Urotropin, 40 to 60 grs. daily, has been of great service combined with drinking of large amounts of water, liquid diet, and laxatives as needed. In addition to the general treatment local treatments have given me the very greatest satisfaction, as will be shown in the subsequent case reports. The local treatment has been almost magical in some cases, especially in those patients who had great distress in the bladder or kidney region. It is probable that the mere mechanical opening of the ureter may have done more good than anything else, as the fever often would drop to normal immediately after treatment, as if an abscess had been drained. Argyrol had been the drug of choice. From 3 to 5 ccm. of a 10 per cent solution have been injected into the pelvis after cleansing with sterile water. It is somewhat difficult to see how the mere application of any antiseptic solution which is washed away so quickly by the urine could have lasting effect upon the local inflammation; it probably has little or no value. In some cases I have given treatments daily until the trouble was relieved, with apparently good results. Bacterins have been tried, and their value is wholly undetermined. The above treatment combined with rest in bed has given the best results in my practice.

Herewith I am submitting five case reports which show in detail the symptoms, treatment, and conclusions.

CASE 1. Acute pyelitis of left kidney; pregnancy.

Personal history. She had been an unusually healthy young woman. She had a baby 18 months old and gave no history of any trouble with her first pregnancy.

Present illness. Six days before I saw her she began to have painful urination at frequent intervals, but got relief shortly after passing the urine; this condition had lasted for two days when she noticed that there was a more or less continuous pain of slight degree and some soreness present; at every urination the pain was worse, but probably not more acute than at first. About this time she noticed slight pain and soreness in the region of the left kidney; this did not disturb her very much, but it gradually grew more painful until she had real suffering with it. Four days after the beginning of frequent urination she had a chilly sensation followed by fever and great pain in the region of the left kidney; from then on she had frequent rigors with high fever following and continuous fever in the intervals. These chills came on irregularly and were nearly always accompanied by attacks of colicky pains in the left kidney and sensations of slight pain along the left ureter. With her physician I saw her on the sixth day of her illness and found in addition to the above history that she was very nervous and in quite a good deal of pain. She had been given morphine in one-half-grain doses from two to four times daily during the last two days and was easy only when completely under the influence of the drug. These attacks of pain were very suggestive of kidney colic due to stone. The urine contained free pus and many bacilli; it was acid and there was no blood; albumin was present, but no sugar; the specific gravity was 1,024.

Examination. The region of the left kidney was very painful, but no swelling could be detected. The bladder was not involved; neither did the ureteral opening show marked change; the urine from the left kidney contained much pus and many epithelia and bacilli. The right urine was normal. The left urine contained some albumin and a few hyaline casts.

Treatment. The left kidney pelvis was irrigated until the urine came away clear; following the irrigation with sterile water a 12 per cent solution of argyrol was injected until a slight sensation of discomfort was noticed. This treatment was given about ten o'clock in the morning of the sixth day of her illness. That afternoon she complained of considerable pain in the region of the left kidney, but nothing like what she had experienced several times daily before the treatment. Morphine was given once during that afternoon; the fever did not come up as usual and by the next morning her temperature was normal and remained so thereafter. She felt somewhat sore in the kidney region for about forty-eight hours, but she never had another attack of pain and received no morphine, except the one dose given immediately following the ureteral catheterization. Her subsequent history is without incident.

Comments. This is a typical case of pyelitis in a pregnant woman. The family physician had correctly diagnosed the condition and called me in to give the treatment locally. The severe attacks of acute pain were due, in all probability, to the blocking of the ureter by acute swelling of the mucosa, or by pus accumulation in the ureter at one or the other of its normal constrictions. The systemic condition was due to septic absorption, and as soon as drainage was established the general condition was relieved and recovery took place rapidly. There was no recurrence of the trouble. As to the value of the local applications I am unable to say. While no cultures were made to determine the nature of the infection, it is probable that the colon bacillus was the only organism present. Evidently there must have been some slight involvement of the kidney itself, as there was local soreness and swelling which remained for some few days after other conditions were relieved.

CASE 2. Acute pyelitis following acute infectious arthritis.

Previous history. This patient was a healthy young woman until about two years ago, when she had a gonor-

rhœal infection which involved the uterus and tubes and finally ended in bilateral pus-tubes and a collection of pus in Douglas' pouch following an early induced abortion. She was operated upon for this by vaginal incision and evacuation of pus. She had a rather long and tedious recovery, which left her general health very much impaired. She continued her calling, more or less clandestinely, between recrudescences of pelvic inflammation, which recurred rather frequently thereafter. During this time she was a patient of mine, but persistently refused to have any radical operative work performed. About two years following the beginning of her trouble she developed an acute multiple arthritis, which was diagnosed acute articular rheumatism, as it bore no resemblance to a gonorrhœal arthritis. All the joints became practically well, except the left knee-joint, which persisted for some weeks in an acutely swollen condition. During all this time she was carrying a variable rise of temperature, with occasional rather high fever, when a new joint would be involved or she would commit some indiscretion in eating. During one of these attacks she began to complain of quite a severe pain in the region of the right kidney. This was accompanied by chilly sensations and rapid and erratic rises of temperature. Practically ever since the inception of her first illness two years ago she suffered from an irritable bladder; but during this last attack of high fever she developed a most distressing dysuria and frequent desire to urinate. These symptoms were not given due consideration, as they had been so common prior to this, until the pain in the region of the right kidney became almost unbearable, when examination disclosed a swelling in the right loin, which bulged somewhat forward and was exquisitely tender. The whole mass was movable on respiration and gave every evidence of being an enlarged and tender kidney. The urine, which had been examined repeatedly, began to show pus and some albumin; infection of the pelvis of the kidney was suspected.

Examination. By this time she was able to sit up and the joints were not paining her at all, but the left knee was slightly swollen. She was brought to my office and examination of the bladder was made. The bladder mucosa was apparently normal, except some slight redness of the trigone and marked redness around the urethral orifice. The ureteral catheter was passed into the right pelvis and a great gush of pure pus of such consistency as to flow easily through a No. 6 catheter came down and she immediately said that she felt better. The catheter drained away several ounces of pus and the pelvis was most thoroughly irrigated with sterile water.

That day the temperature dropped to normal and she began to improve and the urine cleared rapidly, so that within a week's time she was free from any evidence of trouble, except that there was still quite a good deal of pus in the urine. She was so much improved that she would not permit further local treatment of the kidney pelvis, and three weeks later her urine was normal and so remained. In addition to this one local treatment she was given urotropin freely, and the drinking of large amounts of water was advised. The urine was at all times acid. No examination for the organisms was made, except when examining for pus bacilli were noted present.

Comments. This case shows a marked antecedent history of infection, both of the gonococcus and of some undetermined bacillus. It was confined to the right kidney and was relieved almost immediately by draining off the pus which had accumulated in the pelvis of the kidney; after drainage was once established, it probably continued without interruption. Undoubtedly the kidney itself was affected also, as the drainage did not remove the tumor in the kidney region completely, nor did the soreness pass off at once; but as the urine cleared the mass disappeared until when I saw her last, several months later, she gave no evidence of ever having had pyelitis. The urine did not contain casts, although I expected to find them present. Had I used any local medication I would have attributed the rapid recovery to its efficacy. It seems highly probable that kinking of the ureter, or mechanical blocking, or the fact that the kidney was freely movable, may have been a factor in the condition, and that as soon as drainage was established the kidney had no trouble in throwing off the infection.

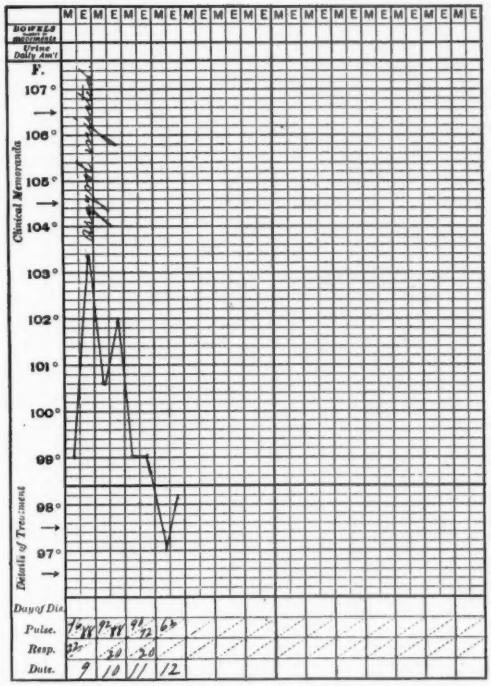
CASE 3. Acute pyelitis; right unilateral; traumatic.

Previous history, negative. A strong, healthy German farmer, 52 years old.

Present illness. Two weeks ago he was struck by a bale of hay while getting it out of the loft in his barn; the bale of hay hit him somewhat of a glancing blow over the region of the right kidney in front and on the right side. The blow was of such slight consequence that he paid very little attention to it at the time, but later during the same afternoon he felt some pain and soreness in this region. The night following he complained quite a good deal of his side and had frequent urination. Fever came on next day associated with general aching and soreness. He did not attribute his illness to the injury to his side and, in fact, did not think that the trouble was due to the injury. His physician was called and treated him for several days, giving him remedies usually prescribed for minor ailments. The urine was examined and found full of pus and the diagnosis of pyelitis of the right kidney was made. The usual remedies were given and the progress of the disease was somewhat stayed. The pus in the urine never seemed to diminish; the fever continued from 99° to 102° during the interval between the injury and the time I saw him about ten days later. He had lost very little flesh, but had grown perceptibly weaker; his appetite was about gone and he was losing ground. The tenderness was more marked in the right kidney region than at first.

Examination. This was very satisfactory, as the patient was anxious to get well. He was suffering from very little pain and said that he was improved. The urine was very full of pus; the region of the right kidney was swollen, was very tender, and the overlying muscles were tense. A roundish mass, giving the impression of the kidney being greatly enlarged, was occupying the right kidney region. Examination elsewhere was negative. There was no tenderness over the bladder, and urination was somewhat less frequent than at first. He had a temperature of 100.5° and a pulse of 94. Urination had not troubled him greatly, although it was more frequent than normal. He was advised to go to the hospital for a complete examination, which he did the next day. The bladder was found to be normal; the ureters were normal also. The catheterized urines from each kidney showed the following: The right urine was loaded with pus; there was some albumin, but no casts; it was acid. The left kidney urine showed many epithelial cells, but no pus, blood, or casts, and no albumin. On entrance the temperature was 99°, pulse 96; next morning; i.e., the day of the examination, the readings were: temperature 99.2°, pulse 86. The diagnosis of right acute pyelitis, probably due to local injury ten days previously, was made.

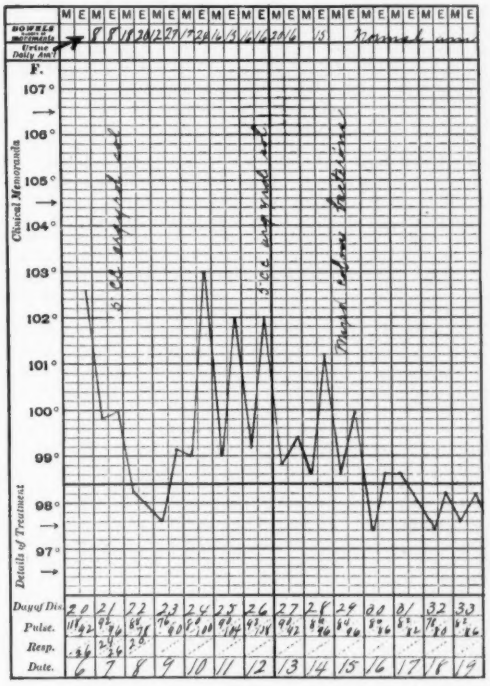
Treatment. At the time of the ureteral catheterization the right kidney pelvis was irrigated with sterile solution and then treated with 5 ccm. of a 10 per cent argyrol solution. Urotropin, in 15-grain doses, was given four times daily; water in large amounts was ordered. The afternoon of the catheterization the temperature rose to 103.4°, but the pulse was only 88. He did not suffer from



Fever chart of Case 3, showing the rapid decline of the fever after the local treatment by drainage and application of argyrol solution.

the examination. Next day the temperature went to 102° and then fell to normal and remained there. He went home feeling well on the afternoon of the twelfth day and has been well since. The urine still had pus in it, but the soreness and pain have become very much less. Subsequent reports show that his recovery was rapid and satisfactory. Exploration of the kidney was advised in case the local treatments were not curative.

Comments. This is very clearly a case of acute pyelitis caused by injury to the kidney itself which lowered the resistance and permitted organisms to set up an inflammation. Although the injury was so grave as to be noticed at the time it was received, the patient himself did not attach any importance to it as a cause of his illness. He became sick the night following the afternoon of the injury with soreness all over, general aching, and the other ordinary symptoms of mild influenza and some bladder irritability. Had it not been for this irritability of the bladder the correct diagnosis by the family physician would not have been made. Cystoscopic examination showed a normal bladder and normal ureteral openings. The pus was under considerable tension and flowed from the catheter readily in a small stream; so it is very probable that the relief of tension and the opening of the ureter with the catheter were the main factors in the rapid recovery rather than the effect of the drugs which were given. The soreness subsided within a few days and the temperature remained normal.



Fever chart of Case 4, showing the rapid fall of the fever after local treatment with irrigation and application of argyrol solution; then the second rise of fever, followed by another treatment with rapid fall of temperature and relief of symptoms. The fever remained normal thereafter, but bladder irritability returned, as shown by the history, but further local treatments gave relief.

CASE 4. Acute pyelitis; bilateral; mixed infection.

Previous history. Female, 43 years old, mother of twelve children; has no pathological history bearing upon the present illness in any way.

Present illness. Without any previous disease of the genito-urinary organs she began to have frequent urination attended with very little bladder irritation for several days; after about four days she began to have a sensation of pain and soreness in the bladder region, especially noticeable following the act of urination. Fever now developed, rising during the afternoons to as high as 104°, accompanied by a chilly sensation when the fever was at the highest. While the range of the fever was irregular it was continuous and associated with an almost constant headache of variable severity, which at times required doses of aspirin to give relief. There was general aching and soreness all over the body; but the bladder symptoms were the most prominent and gave her the most concern. This condition lasted for about ten days when I was called in consultation.

Examination. She was pale, but otherwise apparently well nourished; the temperature was 101°, the pulse 88. She complained very little and said that her bladder was much better than it had been previously, but that she had

headache, occasional chilly sensations, and frequent urination, which was often slightly painful at the end of the act and for a short while afterward. Her bowels had moved regularly from medicines, her appetite was gone, and she felt sick. The abdomen was considerably distended, but not sore except by pressure directly over the bladder and in the upper part of the abdomen along the right rib margin. Palpation elicited soreness over the right loin behind and over the region from the gall-bladder in front to the kidney region along the rib margin; the region of the gall-bladder was tender on deep pressure; the region of the kidney in front was tender to pressure, and here a small mass could be felt which gave pain when pressed and was thought to be the right kidney. Her physician had frequently examined the urine, which from the beginning was found to contain pus and albumin and many bacilli, but neither in marked quantity. The diagnosis of acute pyelitis was made and acid diuretics were ordered, with instructions to drink large amounts of water daily. Owing to the continuous high fever, tests were made for typhoid fever, tuberculosis, and malaria, which were found negative.

Her condition not improving, she was brought to the hospital December 6, almost three weeks from the beginning of the illness. The urine was neutral, 1,020, pale, showed a slight sediment, contained albumin, no sugar, no red cells, no casts, but it contained bacilli, many pus-cells, amorphous urates, and epithelia. The reaction of the urine was neutral owing to sodium bicarbonate being given. The blood examination gave a leucocytosis of 20,000, total, with 80 per cent polynuclears.

She was cystoscoped December 7th. Catheters were passed into both ureters and separate studies made of both urines as follows: Right urine was cloudy, neutral, had large amount of pus; left urine was neutral, clear, had small amount of pus. Both urines contained a small amount of albumin and no red blood-cells. A bacteriological examination showed colon bacilli in large numbers and some staphylococci in the right urine, but nothing in the left.

Treatment. The right kidney pelvis was injected with 5 ccm. of a ten per cent solution of argyrol at the time of examination; the left was not injected because it was thought to be free from infection. Following the examination of the urine, she was reëxamined and both kidney pelves were injected with argyrol. Urotropin and hyoscyamus were given, and the drinking of large quantities of water was advised. As she complained of headache and cold feet practically all the time, ice-caps to the head and hot bags to the feet were used almost all of the time. A liquid diet was given every three hours. Immediately following the local treatment on the 7th, the fever dropped and the general symptoms abated very much, but on the afternoon of the 10th the fever and general discomfort returned; so, on the 12th, she was again catheterized and the pelves of both kidneys were reinjected with argyrol solution. The temperature again dropped and she felt much relieved. The temperature came up again during the afternoon of the 14th, but it went down without further local treatment and remained normal for about two weeks, when her physician phoned that she was beginning to have a return of her trouble. During the treatment while in the hospital, she was given 5-grain doses of aspirin when headaches were severe; this was given only occasionally. Also, Sherman's mixed colon bacterins were given once during her stay in the hospital.

She went home on December 20th, and remained free from trouble until about February 10th, when she began to have slight irritation of the bladder following urination. Within a few days slight afternoon rise of temperature was noticed, going up to 100° by the 13th, when she returned for further local treatment. In the hospital the temperature was normal, the urine contained no pus, but some epithelial cells and acid, no casts or blood and no bacilli. Both kidneys were treated and she regained her normal feelings. The same treatment was given on the 20th, when every examination gave normal results in the urine. She has been given colon mixed bacterins regularly twice a week since first leaving the hospital. She was relieved of the bladder irritation after the second local treatment and has had no symptom of it since.

Later report. Since the above notes were written, she has been back to the hospital for reëxamination on account of some slight bladder irritability. Both urines were found to be normal and free from colon infection. There is no soreness or tenderness in the kidney region.

Comments. This patient was thought to have had a mild typhoid or malarial infection at the beginning of her ailment. The possibility of an acute tuberculosis was strongly suspected; even influenza was discussed, as this disease was then prevalent. Tests were made to determine the causative agent, but all were found negative. From a study of the separate urines the correct diagnosis was easily made and the appropriate treatment given. The colon bacillus, associated with the staphylococcus, was the infective agent and the entire process seemed to be limited to an infection of the pelvis of the kidneys. The duration of the attack was somewhat prolonged, but it yielded satisfactorily to local and general treatment. Without a careful examination of the urine, which suggested cystoscopy and ureteral catheterization, the true cause of her ailment would not have been diagnosed.

CASE 5. Acute pyelitis of both kidneys.

Personal history. This patient has not been well during the past few months, although she appears to be robust; during the past three years she has suffered quite a good deal from backache low down in the spine. Almost all of last summer she suffered from pain in the left limb. She consulted a physician, who told her that this pain was due to some womb complaint, and she was treated locally for it. The periods have been normal, except that about five months ago she had a dark colored discharge which lasted for only a few days and then passed off following hot douches. She had had mild leucorrhœa for three years, but local treatments for this relieved her last summer. She is the mother of two children; the youngest is four years old. There is no history of any other pregnancy.

Present illness. On January 28, 1915, she noticed a soreness in the pelvis and a disagreeable sensation in the region of the bladder associated with frequent painless urination; following urination she would have a bearing-down sensation with throbbing in the bladder; during the night she passed urine very often, which disturbed her sleep greatly; during the day she would pass urine often, but not so frequently as during the night. Three days later she began to have slight pain in the region of both kidneys, but much more on the right side. Soreness gradually developed in this region and extended down towards the pelvis. On January 30 (Sunday) she began to have achy sensations all over the body with onset of fever and frequent slight chilly sensations at various intervals. On January 31 (Monday) she was confined to bed and called Dr. Harrington, who prescribed for her. He examined the pelvic organs and could not find sufficient cause there for her trouble. The urine was examined and some macroscopic pus was found; also albumin. At this time she did not complain so much of the bladder trouble as at first, but she did of the chills and fever, from 100° to 104°, following the chills, which came on at irregular

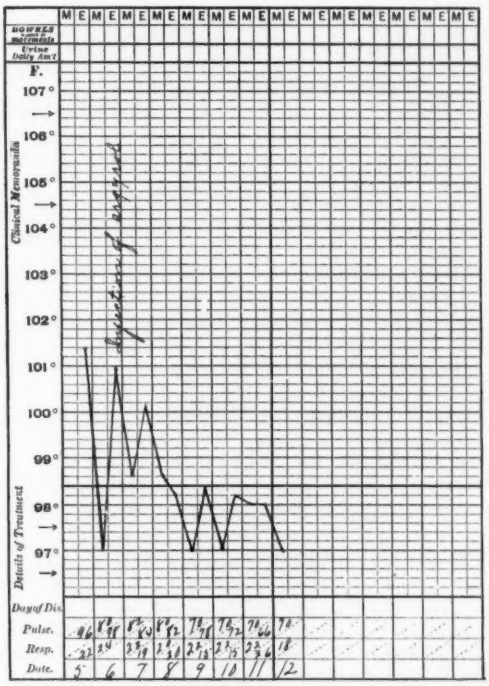
intervals of from six to eight hours. Vomiting followed the chills quite often; she was constipated; she was sore all over the pelvis in front and complained of an aching sensation over the kidney regions.

This condition persisted until I was called to see her with the family physician on Thursday. I found her as above described. The bladder symptoms had somewhat abated, but there was more soreness over the right kidney than previously noticed; on palpation I could detect a movable and enlarged kidney, which was tender on the right, but on the left palpation was negative. While there was tenderness over the pelvis, examination did not show any trouble to explain her feelings.

Diagnosis. Taking into consideration the history and the physical examination, the diagnosis of acute pyelitis was made. It was recommended that she be sent to Providence Sanitarium for examination and treatment.

Treatment. On Friday, February 5, she went to the hospital and on the next morning was cystoscoped and both ureters were catheterized. The bladder was normal; the urine from the left kidney was apparently normal, but examination showed the presence of pus and bacilli; the right urine was quite cloudy with small floculi, which were flakes of pus with many bacilli. Cultures gave positive colon bacilli in pure culture in both urines; a few hyaline casts and some blood-cells were found. The right pelvis was injected with 5 ccm. 10 per cent argyrol solution; the left was not injected, as it was thought to be normal at the time of the examination. Fever, on entrance, was 101.4°, pulse 106. The temperature dropped to normal by the next morning; the next afternoon it was up to 100.4°; it went down to normal every morning with a slight rise in the afternoon until the 7th—two days after treatment—when it remained normal thereafter. On the 7th she was given a dose of 50,000,000 colon bacilli. No other treatment was given. The soreness and pain passed off coincident with the fever. She looks perfectly normal. All other symptoms have subsided. She went home on the 12th; since then she has been well; the urine is normal.

Comment. This patient has been in good health for several months and with no antecedent history which might suggest a possible causal relationship; she gives no history of any recent vaginal or uterine trouble which might be a factor in this illness. Without any previous symptoms of bladder ailment, she began to have frequent painless urination together with a feeling of soreness in the pelvis and the bladder; however, following the act of urination she did have some discomfort as manifested by throbbing and a sense of bearing down in the region of the bladder. This continued for two days before fever set up; this was soon followed by chills and other evidences of infection; at the same time she began to notice some aching in the region of both kidneys, but the aching was more noticeable in the region of the right kidney. The symptoms were so similar to those of some local trouble in the region of the bladder or the pelvis or both regions that the physician examined her for this trouble, but he found nothing in these regions to suggest the cause of the frequent urination and the cause of the systemic infection as evidenced by chills and fever. When the urine was examined microscopically pus was found, which gave the first positive evidence of the location of the real condition behind these various phenomena of frequent and now painful urination, fever, chills, and general aching. A rather peculiar thing now came about: that is the symptom of painful urination subsided without any apparent reason, although the fever and other general symptoms were more marked. This has been observed before in other patients and I do not know how to explain it; it may be due to passing off of the bladder reflex, which is often the first symptom of a kidney involvement.



Fever chart of Case 5, showing the effect of local treatment. Only one was given, but the effect was satisfactory. Neither temperature nor bladder irritability returned.

The diagnosis of acute pyelitis was confirmed by cystoscopic examination and a study of the separate urines. The local treatment of the pelvis of the kidney with argyrol solution gave relief and we feel rather sure that the bacterins were of a certain value. It seems that one can say with some assurance of being correct that the symptomatology of acute inflammations of the kidney pelvis is not correctly interpreted by most physicians, but that since the use of the ureteral catheter has become more general, so much more is being learned about these cases that the diagnosis is becoming relatively easy and accurate.

While the literature of acute pyelitis reports cases without a rise of temperature, yet the cases which I have reported all showed fever at some time during the ailment. I am inclined to the belief that all patients with acute pyelitis have had fever at some time during the course of the disease and that to find a patient without fever at the time of the examination does not prove conclusively that the entire duration of the disease was afebrile.

It is not an uncommon occurrence to see pa-

tients suffering from acute pyelitis which has been diagnosed malaria (especially in the South), typhoid fever, colitis, infected kidney from stone, etc., but more often, probably, has a mistake been made in the diagnosis of low-grade fevers following childbirth as puerperal fever when it was pyelitis. There are some few cases which run the entire course without any localizing symptoms referable to the kidney, and unless the urine be carefully examined the correct diagnosis will not be made; then, again, many cases are diagnosed cystitis because all of the symptoms are located in the bladder. In these cases a cystoscopic examination with catheterization of the ureters is an absolute necessity to determine the nature of the disease.

In the great majority of the patients treatment as outlined above is rapidly efficient and easily carried out with very little discomfort to the patient. As to the value of vacc nes I am undecided, as those patients who did not get them seemed to do as well as those who did.

Résumé: Pyelitis is a disease which is very frequently not diagnosed, due to the fact that the symptoms are so often directed to the bladder. There may be no localizing symptoms at all to guide one; unless the urine be microscopically examined, followed by cystoscopy and ureteral catheterization, it is possible to overlook he disease. Tenderness and pain in the kidney may or may not be present, depending upon whether or not there is blocking of the urinary outflow or upon involvement of the kidney substance.

Treatment should be general and local; general treatment should be to secure an acid urine with some drug which will eliminate formaldehyde; also, massive water drinking must be ordered, especially in those patients who have no nephritis; liquid diet is best; rest in bed; and last, and by all means advisable, kidney drainage by the ureteral catheter and local applications.

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POSITION OF STABILITY IN THE TREATMENT OF FRACTURES

By E. B. CLAYBROOK, M.D., F.A.C.S., Cumberland, Maryland

IN spite of the tremendous amount of literature that has appeared in the past six years upon the treatment of fracture, and in spite of the arguments pro and con as to the necessity and indications for direct fixation as against the closed method, the writers have all failed to tell us how to reduce a fracture and to know that it is satisfactorily reduced by the closed method. The articles have all been strong on the diagnosis of fracture, and have elaborated dozens of different ways of applying splints to keep fractures in place, but all the methods or most of them are evidently failures in the hands of the man "on the firing line," or this constant and persistent demand for direct fixation could not live. Now why is this?

There has been so far no definite rule laid down, even by those who argue strongest for direct fixation, as to which fractures should be opened and which not. It seems to rest more with the personal fancy of the man into whose hands the case falls than with anything else; some, as Mr. Lane, claiming that all should be treated by direct fixation, and others that none should be so treated.

Now it seems to me that it is easy enough to make a fairly good working rule, based upon the conditions present in the given case as it comes to be treated. And such a rule based upon the pathological conditions should appeal to the unbiased mind as worthy of consideration and adoption. What we have to say in this paper

refers particularly to fractures of the long bones, but has some bearing upon all fractures.

In the past, most fractures were set about as follows: The limb was pulled straight and the ends manipulated, and when the ends seemed in good position, the limb was put up "in extension," in the hope that the ends were in good position, and that a good result would be obtained. How futile was this hope in many cases has been proved by the fact that of all the malpractice suits instituted in one year in this country 57 per cent were for poor results in fracture cases.

No fracture should be put up in fixation until we have assured ourselves that we have apposition. This can be done in all cases by testing to see if we have what I have termed a "position of stability." I have used this term because it seems to me best to express the idea and the conditions present. When we set a fracture, the patient should have a general anæsthetic, both for the relief of pain and for the relaxation of muscular spasm, but chiefly for the latter. Then the limb should be extended until the ends can be brought into apposition, and, after manipulating them until this seems to be accomplished, the traction should be gently relaxed, the limb being carefully supported. If there is no slipping by of the ends, the lower fragment should be gently pressed toward the body, and, if no slipping occurs, the pressure should be increased to a considerable extent until we are assured that there is no slipping and that the serrations of the fractured ends are engaged and slightly impacted.

If we can get a secure position of stability — it makes no difference how we put up the fracture, provided that we maintain the alignment and prevent axial rotation — we can rest assured that we will get a good result. In the section on fractures in Bryant and Buck's *American Practice of Surgery*, Eve says: "A retention apparatus should be sufficiently tight and unyielding to prevent deep movement of the fragments."

This is a fallacy, and is a dangerous doctrine to appear where it does; because if the serrated ends of the broken bones are not engaged, no apparatus on earth can be put on "sufficiently tight and unyielding to prevent deep movement of the fractured ends" with safety to the part and to the patient. A splint should never be put on with this end in view. This is the very reason that the plaster cast is looked upon with suspicion. Casts have been applied to prevent deep movement of the fracture ends with, at times, disastrous results.

The position of stability is the keynote in the successful treatment of fractures, and strangely enough it has never been emphasized, although those who have argued so ably and eloquently for the promiscuous open fixation have been always striving for this end only — a position of stability. That is all that plates, pegs, nails, wire, inlays, and what-not can give us. So why not get down to basic facts? If we can get a position of stability with the fracture closed, we should by all means put it in fixation without resort to operation. The form of fixation is immaterial, provided it meets the two essential requirements of maintaining alignment and preventing axial rotation. I believe that each man should use the form of fixation that he feels he can handle best, but that plaster is far the best and safest if well applied by one who knows how. It always fits, is cheap, easy to get, and is the most comfortable of all dressings if properly applied. But its proper application is an art in itself, and must be learned just as surely as any other procedure in surgery.

It is astonishing how many fractures one sees put up in fixation that does not fix. It seems that many men are slow to learn that no fracture of a long bone, unless close to a joint, can be successfully treated unless the fixation extends to, and includes, the joints next above and below the site of fracture.

It stands to reason that if the theory of a position of stability is correct, that any treatment by constant traction is incorrect as a routine. I believe that Buck's extension has been responsible for nearly as many permanent cripples as has tuberculosis of the hip-joint. The idea of extension is that it will maintain the length of the limb until healing takes place. We all know that it does not. To quote Eve again: "In all fractures of the middle and upper third of the femur, shortening is inevitable, and if it does not exceed one inch, the treatment should be regarded as satisfactory." Following this he extols Buck's extension as the best means of treatment. The other and newer methods of extension cannot possibly produce different results, but they may possibly achieve the same bad results with less pain and discomfort to the patient.

The *bone itself* is the best thing to maintain the length of the limb, and even if the bone has been broken, if we *get the ends together, and keep them together*, the limb is not going to be shortened. If we get a good position of stability, the exaggerated muscle tone, or muscle spasm, is our best ally in maintaining this position of stability, so why should we kill off this ally at the beginning of the fight? If we cannot, after repeated

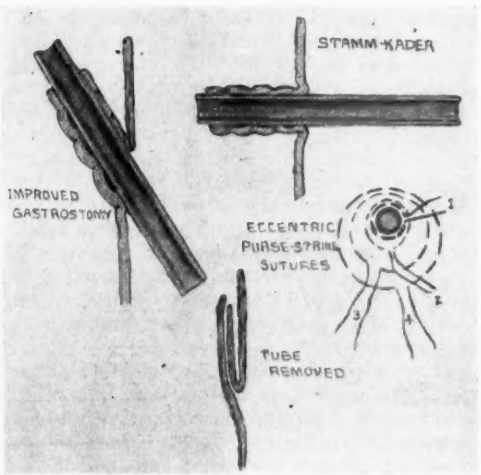
attempts, secure a position of stability, it means that the ends are so oblique, or are of such a shape, that they will not engage and hold together, or that soft parts are interposed and keep the ends from engaging. When we know that this is so, reason demands that we open the limb and get a position of stability by direct fixation, with plate or some other device, if we expect to get a good result, and we should regard that as the only proper treatment. But we should always bear in mind that direct fixation is never an emergency operation, never to be lightly undertaken, and never to be attempted, except by the specially trained in surgery, and in such surroundings as will insure absolute surgical asepsis. We should also remember that, for some reason, bones unite slower after open than after closed reposition. All the authorities seem to agree that the primary clot has no part in the formation of callus, or the regeneration of the bone, but I do not believe it. I believe that it is a most important primary preliminary step, and that when we destroy it, or it fails to be present, as in compound fractures, the delay in union results, not from a mild infection as claimed, but from lack of the primary clot.

If we establish a rule of this kind and work faithfully to get results, we will find that the more experience one has in this work the greater will be the percentage of cases in which a position of stability can be secured, and consequently fewer and fewer will need open fixation. The open method should not claim more than from 5 to 10 per cent in good hands. But when there is no chance of getting a position of stability, no other procedure should be considered, and the indications for open operation are plain.

AN IMPROVED GASTROSTOMY

By MILTON R. BOOKMAN, M.D., F.A.C.S., New York
Adjunct Attending Surgeon, Lebanon Hospital

IT occurred to the writer that if the purse-string sutures placed about the tube, Lembert fashion, in a Stamm-Kader gastrostomy, were inserted in an eccentric manner instead of concentric, the cone-like nipple in the interior of the stomach would be produced in addition to the long channel in an upward direction, as in a Witzel. The cone within the stomach thus placed parallel to the anterior wall would act as a valve to prevent the regurgitation of food through this new gastric fistula.



In a recent case of inoperable mediastinal tumor (extra-œsophageal), in the service of Dr. Parker Syms, to whom I am indebted for operating, this procedure was carried out with most gratifying results. A circular purse-string deep Lembert of Pagenstecher linen was placed well up near the lesser curvature, the stomach opened, tube inserted, and the suture tied. The next suture was begun at least a half inch below the tube and carried around in a circular manner so as to pass less than a quarter-inch above the tube, then passed around to where the suture began and there tied. This pointed the tube within the stomach upward; two more sutures were placed in a like manner, the tube fastened to the stomach and abdominal wall, and the wound closed.

As more of the gastric wall was utilized below than above, the lower part acted as a spring and forced the apex of the cone close to the anterior wall of the stomach, and the channel, being entirely within the stomach and movable, created a distinct valvular action.

This technique may be utilized in making a jejunostomy or cæcostomy, the apex of the cone always pointing in an aboral direction.

A NON-LEAKABLE TROCAR

By C. JEFF MILLER, M.D., F.A.C.S., New Orleans

IT has seemed impossible to devise a trocar that would not allow a certain amount of leakage around the instrument as the fluid was withdrawn. Some time ago I had occasion to discuss the mechanical defects of several instruments in daily use by the surgeon, with Dr. C. Edmund Kells, of New Orleans, a dentist of national reputation and an inventor of numerous mechanical and electrical devices well known to the mechanical world. Among the instruments mentioned was the trocar. He became interested in the subject and soon after presented me with the instrument described below. I have used it in emptying cysts, pus accumulations, and especially in distended gall-bladders, and found it so satisfactory that I desire to recommend it to the profession.

It is a simple device, easily cleaned, and can be made in any desired size. It must be used, however, in conjunction with a suction apparatus which may be attached to the ordinary hydrant, but preferably with an electric-driven motor attachment, also devised by Dr. Kells and now in use in most of the hospitals in New Orleans. This suction apparatus, with various easily adjusted tips, may be used for emptying cavities, removing fluids from the abdominal cavity, or cleansing bleeding areas, and has the advantage of automatic irrigation, if desired.

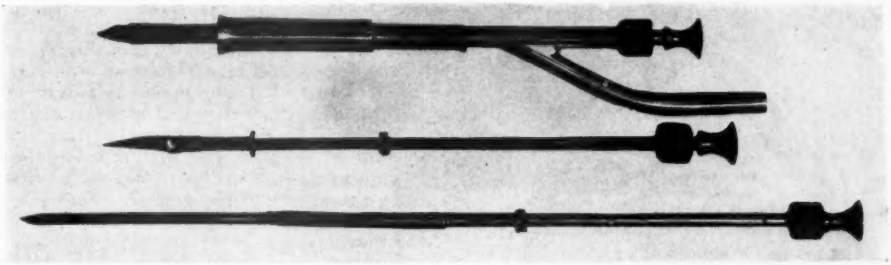
The accompanying illustration and description of the trocar were furnished by Dr. Kells, who will be pleased to give further details to anyone sufficiently interested to write to him.

"This trocar carries a double-sliding and telescoping sheath, the outer end of which is bell-shaped, while the barrel of the trocar is perforated at stated places. The trocar blade is drilled and is carried at the end of a hollow tube, which in turn has an aperture.

"To use, connect the rubber tubing from the aspirating machine to the outlet of the trocar and start the pump. Then, with the trocar withdrawn into the barrel, place the end of the barrel at the point to be punctured. Press the bell of the sheath firmly against the part, hold all firmly, and push the trocar blade down as far as it will go. "By holding the sheath firmly, the barrel can be pushed in to any desired depth; then the trocar blade is rapidly withdrawn its full length, and the contents of the sac are quickly withdrawn by the aspirating device.

"Any fluid that may leak out around the barrel of the trocar is at once sucked into the bell-ended sheath and carried out with the rest of the fluid.

"Trocar blades of any desired shape or aspirating needles of any size or length may be used interchangeably in this device."



Non-leakable trocar used in emptying cysts, pus accumulations, etc.

CORRESPONDENCE

DIAGNOSIS OF EARLY PREGNANCY

To the Editor: A sign of early pregnancy has been described by Labhardt in the *Zentralblatt für Gynäkologie*, 1914, xxxviii, 1017. He described as an original contribution the discovery of a sign of pregnancy occurring as early as the fourth or fifth week, even before, of a livid discoloration of the

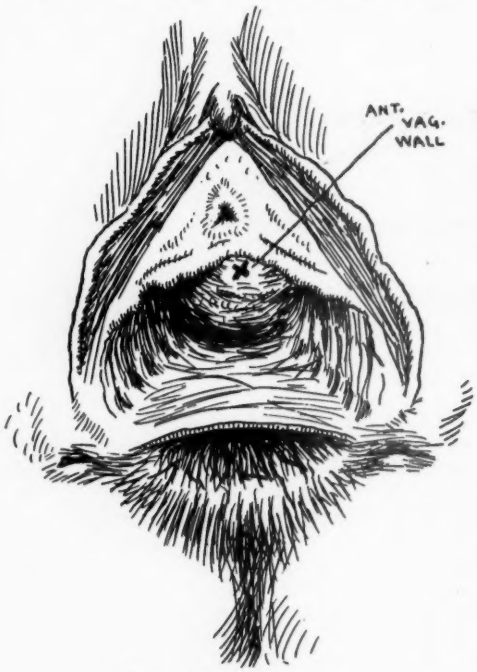


Fig. 1. Jacquemin's spot.

vagina. It consisted of the presence of a band, livid in color, running from one lesser labium to the other in the region just below the urethral opening. He believed that it was due to the congestion of the numerous small vessels running between the bulbs of the vestibule on either side. These vessels lie directly beneath the mucous membrane and are the first to show the congestion.

I have no wish to cause a discussion over the priority of the discovery of this sign, but I believe that it was discovered by a Frenchman named Jacquemin, and was described in a textbook by Parent-Duchatelet, which was translated into German by von Becker in 1837. Kluge, Professor of Midwifery at Berlin, also described this sign after Jacquemin.

In "A Study of One Hundred Cases of Early Pregnancy," I described[1] Jacquemin's sign and drew attention to the spot below the urethra which was first congested, as follows: "In this series of cases, it was found that this hypertrophy of the vessels and venous congestion of the vagina occurred first at a spot upon the anterior vaginal wall about 2 cm. below the orifice of the urethra. This spot later enlarged to spread the violet hue over all the vagina. This spot, called by the author "Jacquemin's spot" (Fig. 1), did not at first show upon the surface of the mucous membrane; as the mucous membrane here has creases and crevices, the sign was seen as streaks of livid, bluish purple at the bottom of these furrows. The phenomenon may best be seen at its first appearance by separating the labia and stretching the mucous membrane of the anterior wall, so that these creases may be opened and the engorged veins exposed. As will be seen from the table, the sign was observed in 57 per cent of the 100 cases before the thirteenth week. In 43 per cent it was absent. It was absent in the very early weeks of pregnancy, present slightly from the seventh to the tenth week, and commonly after the tenth week. As pregnancy advances it is present in a greater proportion of cases, and after the thirteenth week it is a very reliable sign."

This sign was also described in my book entitled *Studies in Gynecology and Obstetrics*.

My article was accompanied by numerous illustrations, the first of which accompanies this letter, and shows the point described by Labhardt and which I, wishing to give credit where credit is due, named "Jacquemin's spot." My article was widely reviewed and was written to describe another sign of pregnancy which I believed to be really new and original with me.

ELLICE MCDONALD.

New York.

[1] Am. J. Obst., 1908, lvii.

Clinical Congress of Surgeons of North America

SIXTH ANNUAL SESSION

BOSTON

OCTOBER 25 TO 29, 1915

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THE HOSPITALS AND MEDICAL SCHOOLS OF BOSTON

II. BOSTON UNIVERSITY SCHOOL OF MEDICINE

BY HORACE PACKARD, M.D., F.A.C.S., BOSTON

Boston University School of Medicine was founded in 1873 as a part of the newly established Boston University, the opening exercises being held on November 5th of that year. Its aim has been: to give its students a broad and sound training in the fundamental sciences of medicine; to make useful, practical, liberal, and successful physicians, true healers of the sick; to impart a working knowledge of modern surgery, obstetrics, and the specialties; to uphold high standards of medical education; to inculcate lofty ideals of ethics and morals.

From its inception its doors have been open to students of both sexes on uniform terms and conditions. The school has made a special feature of giving its students thorough training in the principles and practice of homœopathy.

At its inauguration, entrance examinations were required of all applicants who were not college graduates, which at that time was a marked innovation. So far as is known, it was the first medical school in the country to offer a graded course of three years (1873), and it was one of the first to make such a course compulsory (1877). It was the first medical school in this country to offer a four years' course (1878), also the first to make the four years' course compulsory (1890), while in 1907 an optional five years' graded course was instituted, in which it was also first. The annual sessions were lengthened to eight months each in 1878, and courses leading to the degrees of Bachelor of Medicine and Bachelor of Surgery were offered. Twenty years later, in conjunction with the College of Liberal Arts of the Boston University, a six years' course made its graduates eligible to the degrees of Bachelor of Science and Doctor of Medicine, while now, under specific conditions, the degree of Doctor of Philosophy is conferred by the Graduate School of Boston University.

The chief features of the five years' course which the school first offered in 1907 are briefly

Robert Dawson Evans Memorial Research Building.

outlined as follows: During the first four years study is confined to the regular four-year curriculum. In the fifth year a minimum of 500 hours in special laboratory or clinical work is required, under the direction of the executive committee. Eight months' service as an interne in a hospital of at least fifty beds will be accepted in lieu of 300 hours' work; or twelve months' service in lieu of 400 hours. At the completion of the first four years, the degree of Bachelor of Medicine or Bachelor of Surgery is conferred upon duly qualified students, and those who satisfactorily fill the requirements at the end of the fifth year receive the degree of Doctor of Medicine *cum laude*.

By the coöperation of the College of Liberal Arts and the School of Medicine, in 1908 Boston University offered a combination course whereby the two degrees Bachelor of Science and Doctor of Medicine may be acquired in six years of study. The essential feature of this course is the recognition of the cultural and practical value of such independent sciences as anatomy, embryology, histology, physiology, bacteriology, medical chemistry, and pathology, sciences which are acknowledged as the fundamentals of medicine. Two years in the College of Liberal Arts, including full courses in physics, biology, chemistry and modern languages, plus two years devoted to the fundamental medical sciences in the Medical School are required to obtain the Bachelor of Science degree. An additional two years in the Medical School completes the course and furnishes the required four years for the conferring of the degree of Doctor of Medicine.

CLINICAL FACILITIES

At the present time no medical school that lacks hospital wards and clinics is equipped for work, and Boston University School of Medicine is especially fortunate in possessing the closest affiliation possible, excepting organic union, with a large hospital, the Massachusetts Homœopathic Hospital. The facilities afforded by this institu-

Boston University School of Medicine.

tion are evidenced by the annual report for the year 1914, which shows that during the year 23,260 patients were treated in the various departments of the Hospital. In the wards of the main hospital 6,533 patients received treatment; of these, over 3,500 were in the surgical wards, and over 1,000 in the obstetrical wards. At the Haynes Memorial for Contagious Diseases 838 cases were treated. In the out-patient department 12,188 new patients were treated, and over 1,100 major and 2,000 minor surgical operations were performed. The hospital includes medical, surgical, and maternity wards; wards for special work on the eye, ear, nose, and throat; special children's department; out-patient department; contagious hospital; and the Robert Dawson Evans Department for Clinical Research. A new maternity capable of accommodating upwards of 1,200 cases annually is nearing completion. In addition, clinical facilities of great value are offered by the Cullis Home for Consumptives and the Westboro Insane Hospital, where the state cares for a daily population of over 1,200 patients in all the various forms of mental aberration. Thus the abundant clinical facilities of the school furnish the instructing staff and the students practically an *embarras de richesse*.

CLINICAL TEACHING

In keeping with the spirit of the age, the school has to a large extent substituted clinical teaching, conferences, recitations, and quizzes for the didactic lecture courses. The latest plan has been to devote the morning hours, 9:00 to 1:00, throughout the senior year to clinical work; to divide the class into small sections; to allow each student personally to assist in surgical operations; to assign students in small groups to a five weeks' service at the State Hospital for the Insane at Westboro, and to a five weeks' forenoon service at the Contagious Hospital; the remainder of the year being divided among medical, surgical, and obstetrical clinics, and the specialties. Such an arrangement brings senior students into the most intimate contact with actual medical and surgical work and gives opportunity to acquire a technique impossible to obtain in any ordinary lecture course.

The first faculty of the school comprised a list of twenty-six professors and instructors. Today

At left, Robert Dawson Evans Memorial Research Building. Left center, Boston University School of Medicine. At right, Massachusetts Homœopathic Hospital.

the entire faculty includes a list of seventy-three; a number large enough to utilize effectively the facilities at the disposal of the school.

POST-GRADUATE COURSES

Since 1910 the school has offered post-graduate courses which run about six weeks. Fourteen such courses are at the present time available, covering medicine (homœopathy), surgery, pathology, and the specialties. These courses are adapted to the needs of the general practitioner, but opportunities for pursuing special investigations along selected lines, pathological and clinical, can usually be arranged for.

MEDALS AWARDED FOR SCIENTIFIC EXHIBITS

Two gold medals have been awarded the Boston University School of Medicine for demonstrations of the originality and special excellence of the work done in its pathological and physiological laboratories. The first, at the Louisiana Purchase Exposition held in St. Louis in 1904, on an exhibit which included, among other things, photographs of students performing experiments in the Physiological Laboratory, with chest pantographic, sphygmographic, cardiographic, and other tracings, done by the students under the instruction of Professor A. W. Weysse, and a series of anatomical and pathological specimens prepared and mounted by the gelatine process perfected by Dr. W. H. Watters, Professor of Pathology and Curator of the Museum. The second medal was awarded at the Lewis and Clark Exposition held in Portland, Oregon, in 1905, also for evidences of work done in its physiological and pathological laboratories.

Haynes Memorial Buildings for Contagious Diseases.

The latest award made to Boston University School of Medicine is that of a silver medal, bestowed as a second prize at the International Tuberculosis Congress, held in Washington, D. C., October, 1908. The exhibit shown by the school consisted of specially prepared pathological specimens which demonstrated various lesions of tuberculosis in the tissues and organs of the body. After the Congress the exhibit was borrowed by the state and included in the educational exhibit held under the auspices of the State Board of Health in the city of New York during the winter months of 1909, during which period it was visited and inspected by about three quarters of a million of people. Later it was loaned to the Tuberculosis Exhibit of Philadelphia and was still further used for educational purposes. The widespread influence of such an exhibit cannot easily be estimated, and its power to win such recognition as a silver medal in open international competition testifies eloquently to its merits.

PRELIMINARY CLINICAL PROGRAM FOR BOSTON MEETING

MASSACHUSETTS GENERAL HOSPITAL

Monday

C. A. PORTER — 9. Operations: Goiter. Cancer of stomach.

D. F. JONES — 9. Operations: Cancer of rectum (first stage).

R. C. CABOT, HUGH CABOT, and OSCAR RICHARDSON — 10. Demonstration: Comparison of clinical evidence with postmortem findings.

HUGH CABOT et al — 2. Operations: Epididymectomy for tuberculosis. Litholapaxy for stone in bladder. Ureterotomy for stone.

C. L. SCUDDER — 3. Demonstration: Fractures.

HUGH WILLIAMS — 3. Demonstration: Cases.

Tuesday

E. G. BRACKETT and R. B. OSGOOD — 9. Operations: Excision of knee, with bone plates. Exploration of knee joint through median incision.

D. L. EDSALL — 10 Clinic.

C. L. SCUDDER and H. F. HEWES — 10. Demonstration: Diagnosis and treatment of chronic gastric ulcer.

G. W. W. BREWSTER — 2. Operations: Hysterectomy for fibroids. Appendectomy.

LINCOLN DAVIS — 2. Operations: Ureterotomy for stone. Hysterectomy.

ROGER I. LEE and BETH VINCENT — 2. Demonstration: Splenectomy for pernicious anæmia.

C. C. SIMMONS — 3. Demonstration: Osteomyelitis.

G. A. LELAND, JR. — 3. Demonstration: Anthrax.

Wednesday

F. G. BALCH — 9. Operations: Prostatectomy. Abdominal tumor.

R. B. GREENOUGH — 9. Operations: Benign tumor of breast. Cancer of breast.

Z. B. ADAMS, H. A. DANFORTH, and C. H. BUCHOLZ — 10. Demonstration: Scoliosis.

L. T. BROWN — 10. Demonstration: Postural defects.

FARRAR COBB — 2. Operations: Hysterectomy for cancer (Wertheim).

HUGH WILLIAMS — 2. Operations: Gall-bladder.

R. C. CABOT, HUGH CABOT, and OSCAR RICHARDSON —3. Demonstration: Comparison of clinical evidence with postmortem findings.

Thursday

HUGH CABOT et al — 9. Operations: Nephrectomy for tuberculosis. Pyelotomy for stone. Prostatectomy.

R. C. CABOT — 10. Clinic.

ABNER POST — 10. Demonstration: Congenital syphilis

E. G. BRACKETT and R. B. OSGOOD—2. Operations: Open operation on hip. Gig-saw osteotomy of knee joint.

C. A. PORTER, A. K. STONE, H. F. HEWES, and J. B. HARTWELL — 3. Demonstration: Tuberculous cervical adenitis.

W. J. MIXTER—3. Demonstration: Fracture of the skull.

Friday

C. L. SCUDDER — 9. Operations: Duodenal ulcer. Cancer of stomach. Fracture of femur.

R. B. GREENOUGH — 9. Operations: Cancer of jaw, tongue or lip.

J. C. WARREN — 10. Demonstrations: Reminiscences of the discovery of ether.

C. A. PORTER — 10. Demonstration: Cases.

R. H. MILLER — 10. Demonstration: Tetanus.

C. A. PORTER — 2. Operations: Tuberculous cervical adenitis. Operation on peripheral nerve.

D. F. JONES — 2. Operations: Cancer of rectum (second stage).

Surgical Specialties

A. COOLIDGE, J. P. CLARK, H. P. MOSHER, D. C. GREENE, W. F. KNOWLES, H. A. BARNES, C. ROBBINS, and F. E. GARLAND — Eye, ear, nose and throat clinics, daily.

G. H. WRIGHT — Demonstrations in oral surgery.

J. L. GOODALE — Demonstration: The diagnosis and desensitizing of hay fever.

BOSTON CITY HOSPITAL

Monday

J. B. BLAKE, W. E. FAULKNER, and L. R. G. CRANDON — 9. Operations: Surgical.

F. S. NEWELL, E. B. YOUNG, and N. R. MASON — 2. Operations: Gynecological.

G. P. SANBORN — 3. Demonstration: End results in the tuberculin treatment of lymphnodular tuberculosis.

F. W. WHITE, F. B. LUND, and R. D. LEONARD — 4. Demonstration: Diagnosis and treatment of ulcer and cancer of the stomach (medical, surgical, X-ray).

Tuesday

F. B. LUND, F. J. COTTON, and D. D. SCANNELL — 9. Operations: Surgical.

PAUL THORNDIKE and assistants — 2. Operations: Genito-urinary.

PAUL THORNDIKE — 3. Demonstration: Prostatectomy. Renal calculus.

HORACE BINNEY — 4. Demonstration: Treatment of tumors of the bladder with the high frequency current.

Wednesday

E. H. NICHOLS, H. A. LOTHROP, and J. C. HUBBARD — 9. Operations: Surgical.

J. B. BLAKE, W. E. FAULKNER, and L. R. G. CRANDON — 2. Operations: Surgical.

J. B. BLAKE — 3. Demonstration: Splenectomy for Banti's disease.

A. R. KIMPTON — 4. Demonstration: Transfusion by the use of glass cylinders. Bone tumors. Resection of the stomach for sarcoma.

Thursday

PAUL THORNDIKE and assistants — 9. Operations: Surgical.

F. B. LUND, F. J. COTTON, and D. D. SCANNELL — 2. Operations: Surgical.

F. J. COTTON — 3. Demonstration: Artifical impactions in fracture of the hip. Joint affections. Separations of the lower epiphysis of the femur.

F. B. LUND — 4. Demonstration: Results of operative treatment of fractures, particularly with Parham and Martin bands.

J. H. CUNNINGHAM — 4:30. Demonstration: Congenital cystic kidney. Results of operations for intestinal tuberculosis. Nephrectomy for acute unilateral hæmatogenous infections of the kidney.

F. H. LAHEY — 5. Demonstration: Cardiospasm. Carcinoma of the jejunum. Resection of the rectum with perineal anus.

Friday

F. S. NEWELL, E. B. YOUNG, and N. R. MASON — 9. Operations: Gynecological.

E. H. NICHOLS, H. A. LOTHROP, and J. C. HUBBARD — 2. Operations: Surgical.

E. H. NICHOLS — 3. Demonstration: Results and methods of operating for osteomyelitis. Cerebral surgery.

H. A. LOTHROP — 4. Demonstration: A new operation on the frontal sinus.

J. C. HUBBARD — 5. Demonstration: Sarcoma of the femur. Excision of the transverse colon. Perforation of duodenal ulcer. Transverse duodenal removal of a gallstone. Rupture of the liver.

In connection with the operative clinics, special demonstrations will be given where possible of special methods of anæsthesia: Intratracheal, spinal, etc., by J. E. BUTLER, F. L. RICHARDSON, and N. N. MORSE.

CHILDREN'S HOSPITAL

Orthopedic Department

R. W. LOVETT, A. THORNDIKE, ROBERT SOUTTER, A. EHRENFRIED, A. T. LEGG, J. W. SEVER, and HENRY J. FITZSIMMONS — Daily, 9 to 11. Orthopedic operations: Reduction of congenital dislocation of the hip by various methods, and especially by a special machine. Tendon transplantations, capsule reefing, etc., in infantile paralysis. The use of silk ligaments in infantile paralysis. The operative correction of club foot. The Hibbs and Albee operations for tuberculosis of the spine. The operative treatment for spastic paralysis. Operations for coxa vara. Bone transplantations.

R. W. LOVETT — Monday, 2:30 and 5:10. Demonstration: The treatment of infantile paralysis by muscle training, with exhibition of patients. The treatment of scoliosis by forcible jackets. Application of jackets and demonstration of results.

ROBERT SOUTTER and A. T. LEGG — Monday, 3:15. Demonstration: Exhibition of the results of the operative treatment of infantile paralysis.

E. G. MARTIN — Monday, 3:30. Demonstration: An apparatus to determine the strength of muscles affected by infantile paralysis, with conclusions to be drawn from observations made by it.

J. J. THOMAS and J. W. SEVER — Monday, 4. Demonstration: Obstetrical paralysis and fracture of the acromion process simulating it. Monday, Tuesday and Wednesday, 3. Demonstration: Treatment of paralysis by muscle training.

A. THORNDIKE — Monday, 4:30. Demonstration: End-results in osteoplastic operation for spinal tuberculosis.

PERCY BROWN — Monday, 4:50. Demonstration: Röntgen results in osteoplastic spinal operations. Thursday, 4. Demonstration: Result of röntgen investigation in cases of fibrous stenosis of the pylorus in children. Daily, 10 to 4. Exhibition of röntgenograms, röntgen department.

ROBERT SOUTTER — Thursday, 3. Operation: A new operation for flexion contraction of the thigh in infantile paralysis.

A. T. LEGG — Thursday, 3:30. Operation: Transplantation of the origin of the pectoralis major muscle in paralysis of the shoulder.

A. EHRENFRIED — Thursday, 2:30. Demonstration: Multiple enchondroma.

H. J. FITZSIMMONS — Monday, Tuesday and Wednesday, 3. Demonstration: Treatment of scoliosis with methods in use, cases and records. Thursday, 4:20. Demonstration: Apparatus for reduction of congenital hip dislocations.

PROFS. ERNST, FOLIN, HUNT, CANNON and WOLBACH, DRS. STONE and MORSE — Thursday, 4:30. Clinic: Infantile paralysis.

Visit to orthopedic wards daily, 11 to 12. The new hospital buildings will be open to inspection by visitors daily, 9 to 10.

Surgical Department

J. S. STONE, W. E. LADD, C. G. MIXTER and T. W. HARMER — Daily, 11 to 1. Surgical operations: Harelip, cleft palate, empyema, hernia, cervical adenitis, webbed fingers, hypospadias, undescended testis, etc.

C. G. MIXTER — Tuesday, 2:30. Demonstration: Imperfect and ectopic anus. Wednesday, 2:30. Demonstration: Tuberculous peritonitis. Pyloric stenosis. Undescended testis.

W. E. LADD — Tuesday, 2:30. Demonstration. Cervical adenitis. Wednesday, 2:30. Demonstration: Intussusception. Harelip and cleft palate.

J. S. STONE, W. E. LADD and J. J. THOMAS — Tuesday, 2:30. Demonstration: Fractures in children, subperiosteal and epiphyseal, elbow joint fractures, Volkman's ischæmic contractures.

J. S. STONE — Wednesday, 2:30. Demonstration: Some obscure abdominal conditions. Empyema. Harelip and cleft palate. Acute epiphyseal lesions.

T. W. HARMER — Wednesday, 2:30. Demonstration: The treatment of birthmarks.

PROFS. ERNST, FOLIN, HUNT, CANNON, WOLBACH, DRS. LOVETT, STONE and MORSE — Tuesday, 4:30. Clinic: Cervical adenitis.

DRS. CROSBY, GREENE and F. E. GARLAND, three afternoons. Eye, Ear, Nose and Throat clinic.

Visit to general surgical wards daily, 10 to 11.

PETER BENT BRIGHAM HOSPITAL

HARVEY CUSHING — Daily. Clinics or demonstrations: Surgery of the brain, pituitary body, spinal cord, peripheral nerves.

DAVID CHEEVER and JOHN HOMANS — Daily. Operations: Surgical.

HENRY A. CHRISTIAN, CHANNING FROTHINGHAM, and others of the medical staff will co-operate in giving clinics or demonstrations on selected topics, such as the electrocardiogram, etc.

MASSACHUSETTS HOMŒOPATHIC HOSPITAL

Monday

A. G. HOWARD and H. MOORE — 9. Orthopedic operations: Bone grafting, tendon transplantation.

J. H. PAYNE and D. W. WELLS — 9. Eye operations: Advancement, pulley stitch; advancement, modified Worth; ptosis, Tansley operation; trephining, glaucoma.

DRS. RICE, HOUGHTON, and C. SMITH — 2. Operations: Nose and throat.

W. F. WESSELHOEFT and T. E. CHANDLER — 2. General surgical operations: Gastric ulcer, ventral hernia, inguinal hernia, appendicitis, œsophageal diverticulum.

Tuesday

J. E. BRIGGS and C. T. HOWARD — 9. General surgical operations: Prostate, appendix, goiter, inguinal hernia.

G. A. SUFFA and A. W. HORR — 9. Eye operations: Muscle tucking; advancement, modified Worth; cataract extraction; glaucoma.

HORACE PACKARD and C. T. HOWARD — 2. General surgical operation: Appendectomy, a simpler method of sealing the appendicular stump. Demonstration cases: Prostatectomy, the choice of routes. The control of post-operative hæmorrhage, illustrative operations. Empyema, cases for demonstration. Enteroptosis, cholelithiasis.

DRS. RICE, HOUGHTON, and SMITH — 2. Operations: Nose and throat.

Wednesday

DRS. RICE, HOUGHTON, JOHNSON, SMITH, and BUSH — 9. Operations: Nose and throat.

GEORGE H. EARL and H. MOORE — 9. Orthopedic operations: Congenital dislocation of the hip, bone-grafting, tendon transplantation.

W. F. WESSELHOEFT and R. C. WIGGIN — 2. General surgical operations: Nephrolithiasis.

F. W. COLBURN — 2. Operations: Ear.

Thursday

J. E. BRIGGS and C. CRANE — 9. General surgical operations: Cancer of the breast, appendix, cholelithiasis, nephrolithiasis.

DRS. RICE, HOUGHTON, and C. SMITH — 9. Operations: Nose and throat.

G. R. SOUTHWICK — 2. Gynecological operations: Ovarian cystomata, retrodisplacement of uterus, uterine fibromata, perineorrhaphy.

Friday

G. R. SOUTHWICK and D. G. WILCOX — 9. Gynecological operations.

DRS. A. S. BRIGGS, BOYD, LEE, SEDGELEY, SOUTHER, and THOMAS — 2. General surgical operations.

Demonstrations

W. H. WATTERS — Surgical pathology.

G. A. SUFFA — Opthalmotrope.

Routine examination of ante-partem cases — Wednesday, 10.

Social service clinic for post-partem cases — Thursday, 2.

Daily clinics in twilight sleep.

Daily exhibition of new maternity building.

CARNEY HOSPITAL

J. T. BOTTOMLEY and D. F. MAHONEY — Monday, Wednesday and Friday, 9. Operations: Surgical.

W. R. MACAUSLAND and A. R. MACAUSLAND — Monday, Wednesday and Friday, 9. Operations: Orthopedic.

F. W. JOHNSON and S. RUSHMORE — Tuesday and Thursday, 9. Operations: Gynecological.

FREE HOSPITAL FOR WOMEN

DRS. GRAVES, PEMBERTON, WADSWORTH, HUTCHINS and BAKER — Tuesday, Wednesday and Thursday, 9. Operations: Gynecological.

DR. PEMBERTON — Wednesday, 2:30. Cystoscopic demonstration.

DR. HUTCHINS — Thursday, 2:30. Demonstrations: Laboratory specimens.

ST. ELIZABETH'S HOSPITAL

DRS. LANE and SUPPLE — Monday and Thursday, 9. Operations.

DR. CRONIN — Monday, Thursday and Friday, 10. Ward visit. Wednesday, 9. Intravenous salvarsan injections.

DR. BRODERICK — Tuesday, 9. Orthopedic operations and clinic.

DR. CHUTE — Wednesday and Friday, 9. Operations: Genito-urinary.

DRS. BRAINERD and HOLMES — Tuesday, 9. Nose and throat clinic.

DR. DOWNING — Monday and Friday, 11. Demonstrations: Laboratory technique.

DR. BUTLER — Tuesday and Thursday, 10. Demonstrations: X-ray.

DRS. MCDONALD and MCADAMS — Wednesday, 10. Eye clinic.

The history, diagnosis, and indication for operation, in each case will be discussed previous to operation by Dr. Cronin of the medical service and Dr. Butler of the röntgenological department.

ROBERT BRIGHAM HOSPITAL

CHARLES F. PAINTER, EDWARD RICHARDSON, LLOYD T. BROWN and RICHARD MILLER — Tuesday and Thursday — 10. Operations. Monday, Wednesday and Friday, 3. Clinics: Surgery of chronic diseases, arthritis, intestinal tuberculosis, peritoneal adhesions, hemolytic diseases.

NEW ENGLAND HOSPITAL FOR WOMEN AND CHILDREN

MARY A. SMITH and ABBY M. O'KEEFE — Monday and Thursday, 10. Operations: Gynecological.

ELIZABETH T. GRAY and LETITIA D. ADAMS — Monday, 2; Tuesday, 10. Operations: Gynecological.

EMMA B. CULBERTSON and GLADYS COOPER — Tuesday and Friday, 2. Operations: Gynecological.

FLORENCE DUCKERING and LETITIA D. ADAMS — Wednesday, 10; Thursday, 2. Operations: Gynecological.

MAUDE CARVILL — Thursday, 2. Eye clinic.

MARGARET NOYES — Wednesday, 2. Ear, nose and throat clinic.

ISABELLE D. KERR — Friday, 10. Ear, nose and throat clinic.

Scopolamine-morphia anæsthesia both with and without ether will be used during these clinics. Statistics, covering six years continuous use of this form of surgical anæsthesia, on over 1400 cases, are available. Dr. Abby M. O'Keefe, professional anæsthetist, has entire charge of this department.

LONG ISLAND HOSPITAL

F. H. LAHEY — Monday, 2. Operations.

J. H. CUNNINGHAM — Tuesday and Wednesday, 2. Operations.

ROBERT SOUTTER — Thursday and Friday, 2. Operations.

CODMAN HOSPITAL

E. A. CODMAN — Tuesday, 10. Operations: Surgical. Demonstration of lesions about shoulder joint. Thursday, 10. Operations: Surgical. Demonstration of lesions of duodenum.

HOUSE OF THE GOOD SAMARITAN

DRS. SOUTTER, LEGG and SEVER — Monday, Wednesday and Friday, 10. Clinics: Infantile paralysis, muscle transplantation, flattened condition of the head of the femur, obstetrical paralysis.

MASSACHUSETTS CHARITABLE EYE AND EAR INFIRMARY

DRS. CROCKETT, MOSHER, and EMERSON — Monday and Friday. Otological clinic.

DRS. JACK, WALKER, POWERS and BLODGETT — Tuesday. Otological clinic.

DRS. HAMMOND, WHITE and FAUNCE — Wednesday. Otological clinic.

DRS. JACK, KNOWLES, TOBEY and BOGAN — Thursday. Otological clinic.

Eye clinic daily from 9 to 12. Various operations on lids, tear sac and muscles of the eye. Different types of operation for cataract and glaucoma. Magnet operations for the removal of foreign bodies from the eye. Different methods of using local anæsthesia. Tuberculosis of the eye. Interstitial keratitis of specific origin. Ophthalmia neonatorum and gonorrheal ophthalmia in adults. Localization of foreign bodies in the eye by the X-ray. Demonstration of opthalmometer for measuring astigmatism of the lens. Demonstration of lantern slides by pathological department.

HARVARD MEDICAL SCHOOL

PROFS. COUNCILMAN and MALLORY — Demonstration: Pathology.

PROFS. CANNON and W. T. PORTER — Demonstration: Physiology.

PROF. FOLIN — Demonstration: Chemistry.

PROF. STRONG — Demonstration: Tropical Medicine.

PROF. REID HUNT — Demonstration: Pharmacology.

DRS. ORDWAY and TYZZER — Demonstration: Cancer research.

JOHN WARREN — Demonstration: Anatomy.

W. F. WHITNEY — Demonstration: Warren anatomical museum.

F. T. LEWIS — Demonstration: Embryology.

J. E. GOLDTHWAIT — Demonstration: Visceroptosis.

TUFTS MEDICAL SCHOOL

A. W. GEORGE — Daily, 2 to 5. Röntgenological demonstration.